



Mechanical Property Allowables Generated for the Solid Rocket Booster Composite Nose Cap

A.J. Hodge

Marshall Space Flight Center, Marshall Space Flight Center, Alabama

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Marshall Space Flight Center, Marshall Space Flight Center, Alabama

National Aeronautics and
Space Administration

Marshall Space Flight Center • MSFC, Alabama 35812

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LIST OF ACRONYMS AND SYMBOLS

ASTM	American Society for Testing Materials
CAI	compression after impact
CNC	composite nose cap
DMA	dynamic mechanical analyzer
DNS	double-notch shear
DSC	dynamic scanning calorimeter
E	epoxy
ED20	Structures, Mechanics, and Thermal Department
ED30	Materials, Processes, and Manufacturing Department
FTIR	Fourier transform infrared spectroscopy
G	graphite
IHGF	Improved Hot Gas Facility
MCC	Marshall convergent coating
MSFC	Marshall Space Flight Center
MTS	Materials Test System
P1	prototype
RH	relative humidity
SRB	solid rocket booster
SRI	Southern Research Institute
T_g	glass transition temperature
TPS	thermal protection system
USBI	United Space Boosters, Inc.

TECHNICAL MEMORANDUM

MECHANICAL PROPERTY ALLOWABLES GENERATED FOR THE SOLID ROCKET BOOSTER COMPOSITE NOSE CAP

1. INTRODUCTION

The current Space Shuttle solid rocket booster (SRB) nose cap is a nonrecovered, thermal protection system (TPS) coated, metallic structure. United Space Boosters, Inc. (USBI) and Marshall Space Flight Center (MSFC) initiated a Space Shuttle upgrades project to develop a composite nose cap (CNC) as a replacement article for the SRB. Composite materials offer a strength-to-weight advantage over metallic structures. Additionally, the TPS, a potential debris hazard that adds weight without contributing strength, can be eliminated because of the thermal capabilities of a composite sandwich structure.

The CNC is composed of a sandwich construction. Two facesheets of Hexcel® AS4/3501-6 graphite (G)/epoxy (E) encapsulate a core of Scotch-Core™ SC350G syntactic foam. Significant mechanical testing was performed on the material used in the SRB CNC. The testing was based on requirements set by two MSFC Engineering Directorate Departments (Materials, Processes, and Manufacturing Department (ED30) and the Structures, Mechanics, and Thermal Department (ED20)) and USBI. The testing performed by ED30 provided A-basis allowables for stress analyses performed by ED20.

2. SPECIMEN PREPARATION

2.1 Materials and Processing

The materials selected for the SRB CNC were AS4/3501–6 8H harness fabric of 3K tows fabricated by Hexcel and Scotch Core SC350G syntactic foam. The nose cap was fabricated as a sandwich construction on a male tool with an inner and outer layer of the graphite/epoxy and a core composed of the syntactic foam. The sandwich was cocured in an autoclave for 4 hr at 375 °F and 85 psig pressure. The ramp rate was 2–3 °F per minute, and the cooling rate was 1–2 °F per minute.

Three lots of graphite/epoxy were evaluated. Acid digestion of the matrix material was performed on 6-, 8- and 10-ply laminates of lot 1. Procedure A (nitric acid digestion) of ASTM D 3171 was performed. The resulting fiber weight percents were 66.8, 69.1, and 68.2 for the 6-, 8-, and 10-ply laminates. The fiber volumes were 59.9, 62.7, and 61.6 percent. The results of the acid digestion tests were similar to theoretical values obtained utilizing the sample dimensions and the fabric aerial weight ($\approx 370 \text{ g/m}^2$). Future fiber volume and fiber weight data were obtained by utilizing the aerial weight, number of plies, and sample dimensions.

Fourier transform infrared spectroscopy (FTIR) was performed on the three lots of epoxy resin. No difference was detected among the three lots.

2.2 Test Specimen Geometry

The stress analysis model used lamina level properties. Lamina properties of the graphite/epoxy fabric were determined by four tests: tension, compression, in-plane shear, and interlaminar shear. Tension, shear, and flatwise compression were also performed on the core material. Table 1 outlines the tests performed and properties obtained. The graphite/epoxy test specimens were machined from flat panels fabricated by USBI personnel. The tensile and compression specimens were 6 plies of prepreg (0)₆; the in-plane shear specimens were 8 plies of a balanced, biaxial laminate (± 45)_{2S}; and the interlaminar shear samples were 10 plies of prepreg (0)₁₀. The core material test specimens were machined from eight plies of the syntactic foam film. Test specimens were machined with diamond-end mills per the drawings in figure 1.

Table 1. Overview of the tests made on the samples.

Test	Material	Standard	Properties Obtained
Tensile	Graphite/Epoxy	ASTM D 3039	σ_{11} , σ_{22} , E_{11} , E_{22} , ν_{12} , ν_{21}
In-plane shear	Graphite/Epoxy	ASTM D 3518	τ_{12} , G_{12}
Compression	Graphite/Epoxy	ASTM D 695	σ_{c11} , σ_{c22} , E_{c21} , E_{c22}
Interlaminar shear	Graphite/Epoxy	ASTM D 3846	τ_{13}
Edgewise tension	Core	ASTM D 638	σ_{11} , E_{11}
Flatwise compression	Core	ASTM D 365	σ_{33}
Shear punch	Core	ASTM D 732	τ_{31}

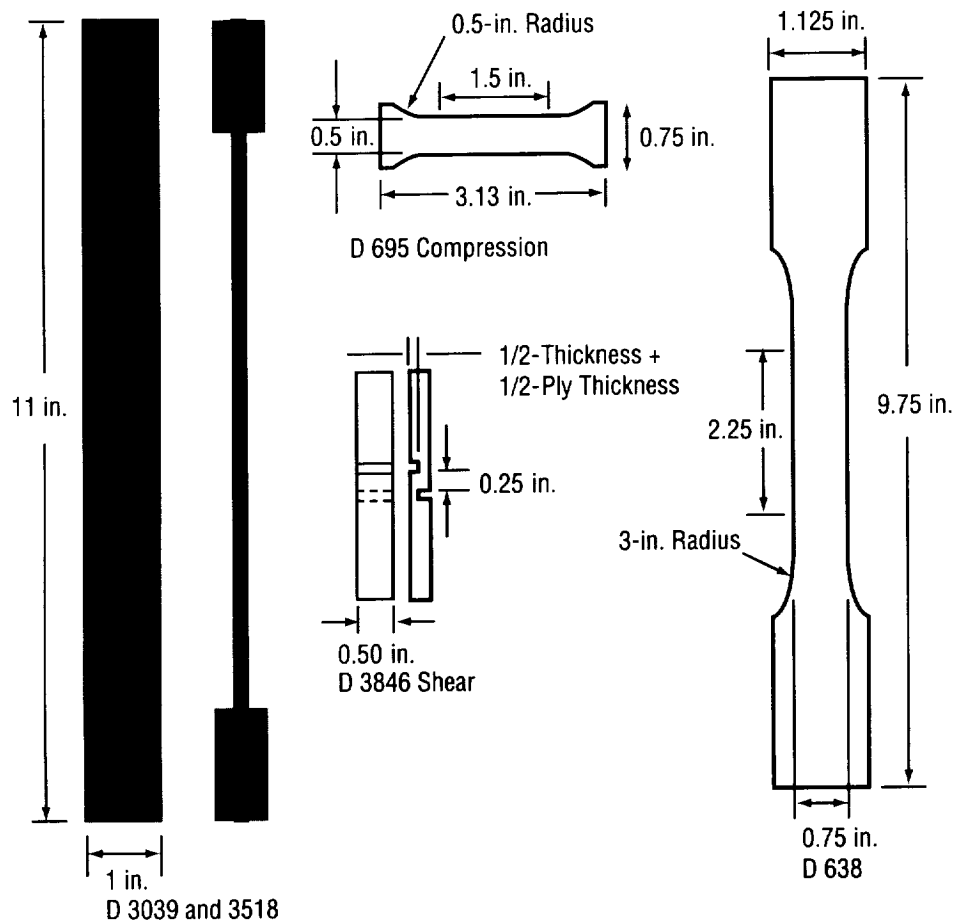


Figure 1. Test specimen geometry.

2.3 Moisture Conditioning

Hypalon® has been qualified for use as a moisture barrier for Marshall convergent coating (MCC)-1 insulation. Initially, Hypalon was to be used as a moisture barrier on the SRB CNC. As a verification of the effectiveness of Hypalon as a moisture barrier, a series of moisture conditioning tests were performed on the AS4/3501-6 material. Ten compression test specimens were coated with four roller coats of Hypalon. Ten specimens were left bare as a control. The specimens were then placed in a humidity chamber at 92.5-percent relative humidity (RH) and 120 °F. Weight measurements were made daily for 2 wk. After 2 wk, the chamber was cooled to 85 °F for 1 wk. The Hypalon-coated specimens actually gained more weight than the uncoated specimens (fig. 2). However, the amount of moisture gained by the Hypalon was indistinguishable from the moisture gained by the composite. There were also portions of the coating that were below the minimum thickness requirement of 8 mils; thus, a second test series was run.

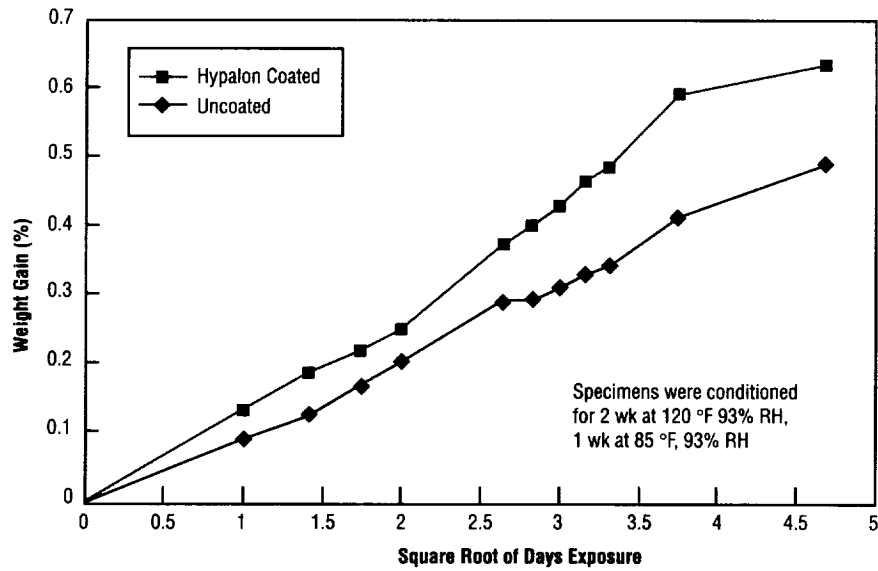


Figure 2. Weight gain of coated versus uncoated AS4/3501-6 composite coupons at 120 °F, 93-percent RH.

The next test series had 10 coated samples, 10 bare samples, and 1 thin film of Hypalon. This second test series was run at 160 °F and 93 percent RH. The Hypalon was applied in six brush coats that produced a minimum coating thickness of 19-21 mils. Using the rule of mixtures, the weight gain of the Hypalon film was subtracted from the weight gain of the Hypalon-coated specimens. This yielded the estimated weight gain of the composite underneath the Hypalon. The bare and coated composites exhibited similar weight gains (fig. 3). Thus, Hypalon was determined to be ineffective as a moisture barrier on low absorptivity materials such as graphite/epoxy.

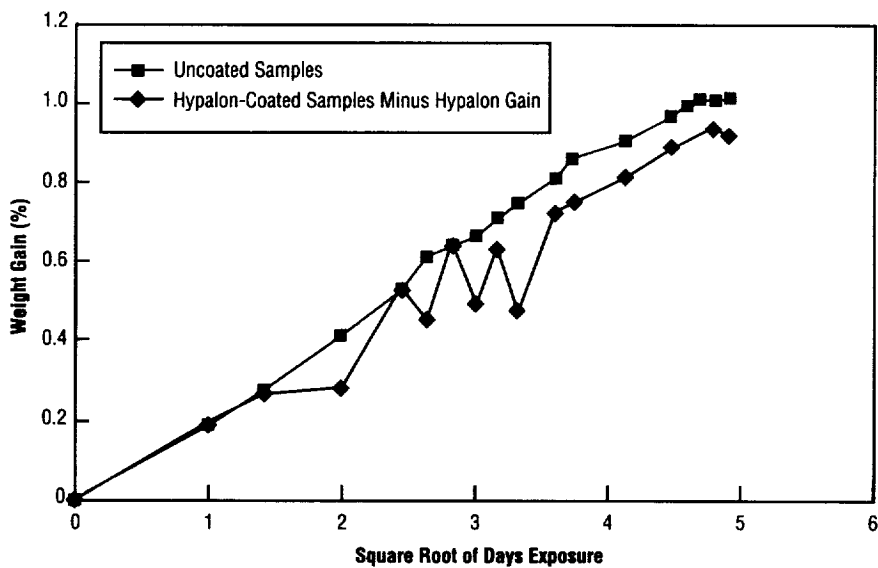


Figure 3. Weight gain of uncoated and Hypalon coated AS4/3501-6 at 160 °F, 93-percent RH neglecting the weight gain of the Hypalon.

The glass transition temperature (T_g) of the moisturized specimens was also evaluated. Unconditioned “ambient” samples had T_g values of 386 and 380 °F obtained from the dynamic mechanical analyzer (DMA) and dynamic scanning calorimeter (DSC) thermal analysis equipment. Additional T_g testing was conducted on specimens conditioned at 180 °F, 93-percent RH after drying for 24 hr at 250 °F. The initial “dry” T_g was 398 °F, measured by DMA. The T_g versus exposure time and T_g versus percent weight gain were determined for a six-ply composite. The major loss in T_g occurs in the first 10 days of exposure. The T_g begins to plateau after \approx 20 days of exposure. Figures 4 and 5 illustrate the results of the T_g testing.

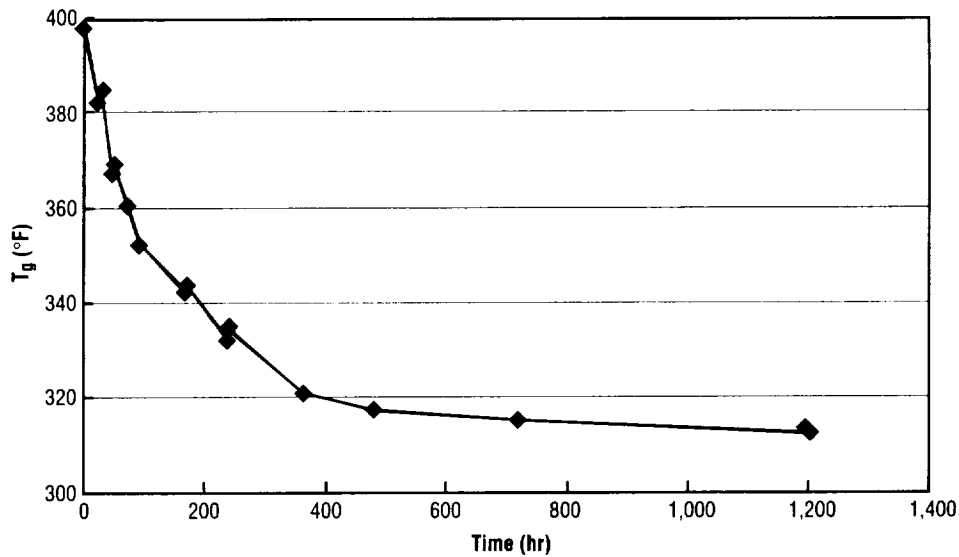


Figure 4. Drop in T_g associated with exposure time at 180 °F 93-percent RH.

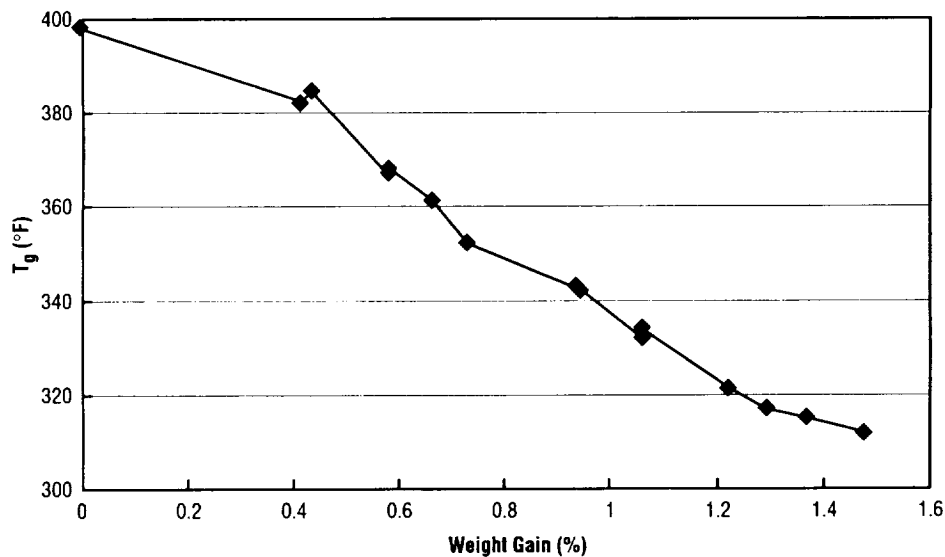


Figure 5. Drop in T_g associated with moisture gain.

Because of the ineffectiveness of Hypalon as a moisture barrier, material properties had to be developed in the “wet” state. MIL-HDBK-17 and ASTM D 5229 recommend that a specimen be moisture conditioned to an equilibrium state before it is considered “saturated.” Equilibrium is defined as a change in weight <0.01 percent in a 7-day period (24 hr, if diffusivity is known). There are no standard moisture conditioning methods. Data generated on 3501-6 in the MIL-HDBK-17 were conditioned for 30 days at 140 °F, 95-percent RH. Hercules generated wet properties on AS4/3501-6 by boiling in water for 24 hr. Cyttec-Fiberite immersed AS4/934 (similar resin) in 165 °F water for 7 days. Based on the data generated on the nose cap material, none of these methods would have sufficient time to reach equilibrium.

The absorption of water into a graphite/epoxy material follows Fick’s second law. The moisture equilibrium content is dependent solely on percent relative humidity. A change in temperature increases the diffusivity of the material. Thus, an increase in temperature at a constant humidity level only decreases the time required to reach equilibrium. The diffusivity was calculated at both 160 and 120 °F for 93-percent RH. Using the Arrhenius relationship, diffusivity was estimated for 180 and 85 °F. The moisture gain due to a 6-mo exposure at 85 °F and 93-percent RH was then estimated. The corresponding time required at 180 °F to reach the same moisture level was also approximated (fig. 6). Assuming two-sided diffusion on a seven-ply laminate, 6-mo exposure at 93-percent RH and 85 °F would yield a 0.7-percent weight gain. One-sided absorption yields 0.3-percent weight gain. To obtain a 0.7-percent weight gain at 180 °F, a six-ply laminate would need to soak for 5 days. Eight- and ten-ply laminates would require conditioning for 9 and 14 days. A 10-day soak should result in moisture levels of 0.9-, 0.75-, and 0.6-percent weight gain for 6-, 8-, and 10-ply laminates, respectively. This is above the expected moisture gain in a seven-ply laminate on the beach when exposed to one-sided absorption. Thus, a 10-day soak of the test specimens at 180 °F and 93-percent RH should conservatively represent a 6-mo beach exposure. Subsequent conditioning at 180 °F, 93-percent RH indicated the estimated weight gains were reasonably accurate. Therefore, all AS4/3501-6 test coupons were conditioned at 180 °F, 93-percent RH for 10 days. To prevent moisture loss, specimens were tested within 8 hr of removal from the conditioning chamber.

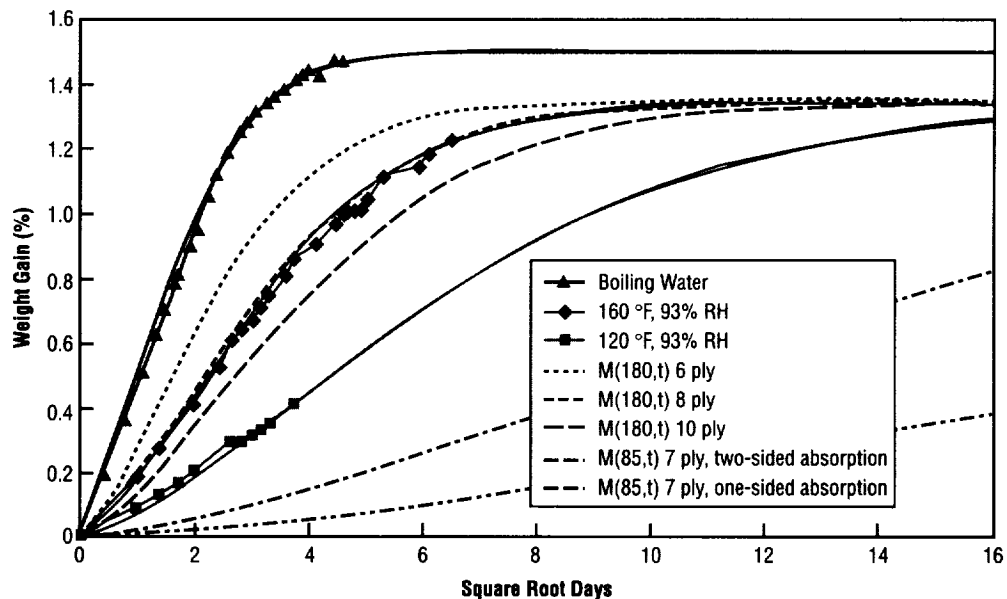


Figure 6. Comparison of moisture conditioning treatments on AS4/3501-6.

3. TEST METHODOLOGY

3.1 Thermal Profile

The CNC will experience a high heat load during ascent. The surface of the nose cap will continue to heat until booster separation. After separation the surface temperature decreases until the nose cap is ejected from the booster. Figure 7 represents the thermal history profile of the saturation point on the CNC. The nose cap must survive the ejection to successfully deploy the drogue chute. Thus, there are several thermal environments where the nose cap undergoes various structural and aerothermal loading. The lamina level mechanical properties were determined at the temperature of the outer ply at booster separation and nose cap ejection. Additionally, the properties were determined at the temperature of the inner facesheet at nose cap ejection. Thus, A-basis properties were determined for the graphite/epoxy lamina at room temperature, 240 °F (maximum temperature of the inner facesheet), 600 °F (maximum temperature of the outer surface), and 350 °F after heating to 600 °F (surface temperature at nose cap ejection). Additional testing was performed at 350 and 480 °F to establish property trends along the thermal profile. A-basis properties were determined for the syntactic foam core at three temperatures: (1) room temperature, (2) 480 °F (maximum core temperature), and (3) 350 °F (maximum core temperature at ejection).

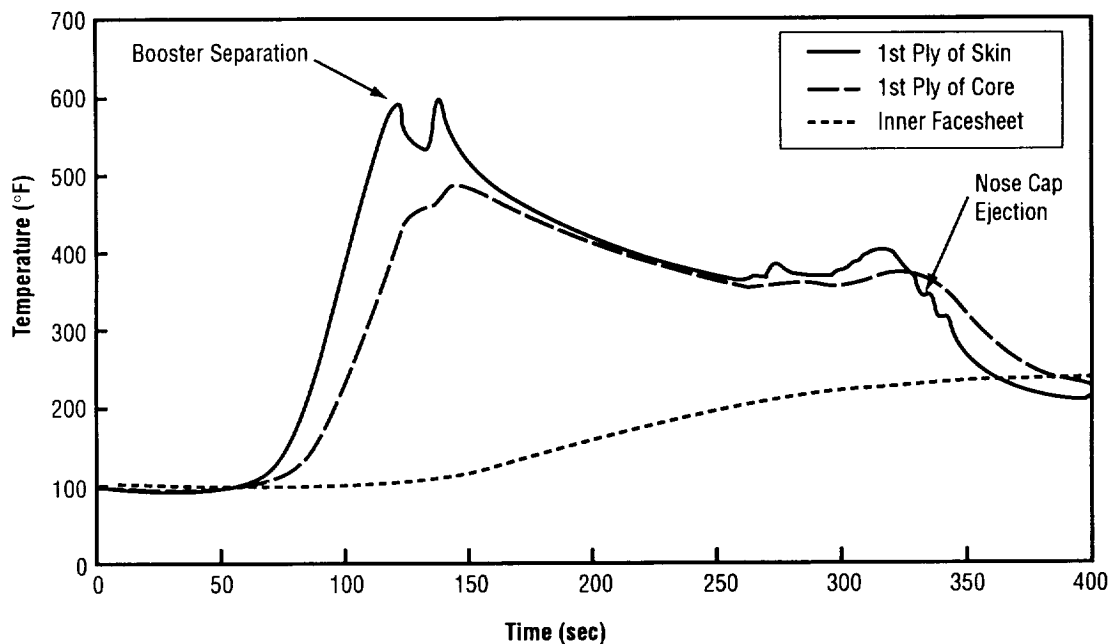


Figure 7. Thermal history of SRB CNC at the saturation point.

Typically, heating rates and hold times at temperature equilibrium are long. However, the properties of the moisture conditioned composite material would change with exposure time if allowed to bake at temperature. This would be most evident at 600 °F, which is well above the T_g . Therefore, the specimens were heated at the same rate as the thermal history profile of the SRB CNC. Exposure time was limited to the duration of the test which was typically <1 min. Specimens tested at the nose cap ejection temperature were rapidly heated to 600 °F, then cooled to 350 °F before loading commenced.

3.2 Lot-to-Lot and Panel-to-Panel Variability

To address concerns of potential variation between different lots of prepreg, three different lots were tested. In addition to examining lot-to-lot variability, processing variability was also addressed. Specimens from each lot came from at least four different panels that were laid up and cured at different times. Thus, specimens came from three different lots, each having four different panels. A-basis values were determined from 30 to 36 separate test specimens. Figure 8 shows the two-stage nested factorial used to determine lot-to-lot and panel-to-panel variability.

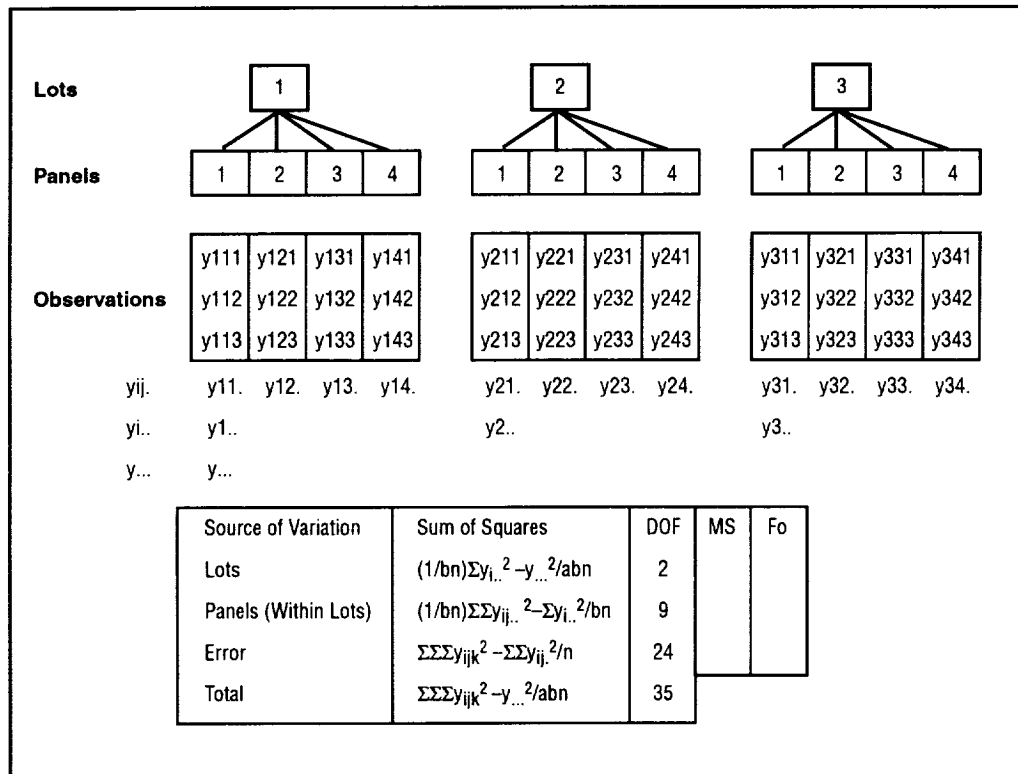


Figure 8. Two-stage nested factorial.

3.3 Tensile Testing

The American Society for Testing Material (ASTM) D 3039 tensile specimens were machined in both the warp and fill directions. Fiberglass tabs were bonded with EA 9394 paste adhesive prior to machining. After conditioning for 10 days in a humidity chamber at 180 °F, 93-percent RH, weight gains

were recorded. The specimens were tested on a Materials Test System (MTS) 880 test machine. Following the flight, thermal history profile complicated testing. The rapid heating rate of 10 °F/sec could not be obtained in a furnace. Thus, alternate heating methods were required. Two banks of quartz lamp infrared heaters were obtained from Research, Inc. Through use of a Dimension controller, different heating profiles were programmed and run. The six quartz lamp bulbs in each bank heated a 4-in. zone on the center of the test specimen. Figure 9 illustrates the tension test setup. Strain measurements were made with MTS extensometers. All load and strain data were stored digitally with MTS Testworks® software. The tensile test rate was 0.1 in./min.

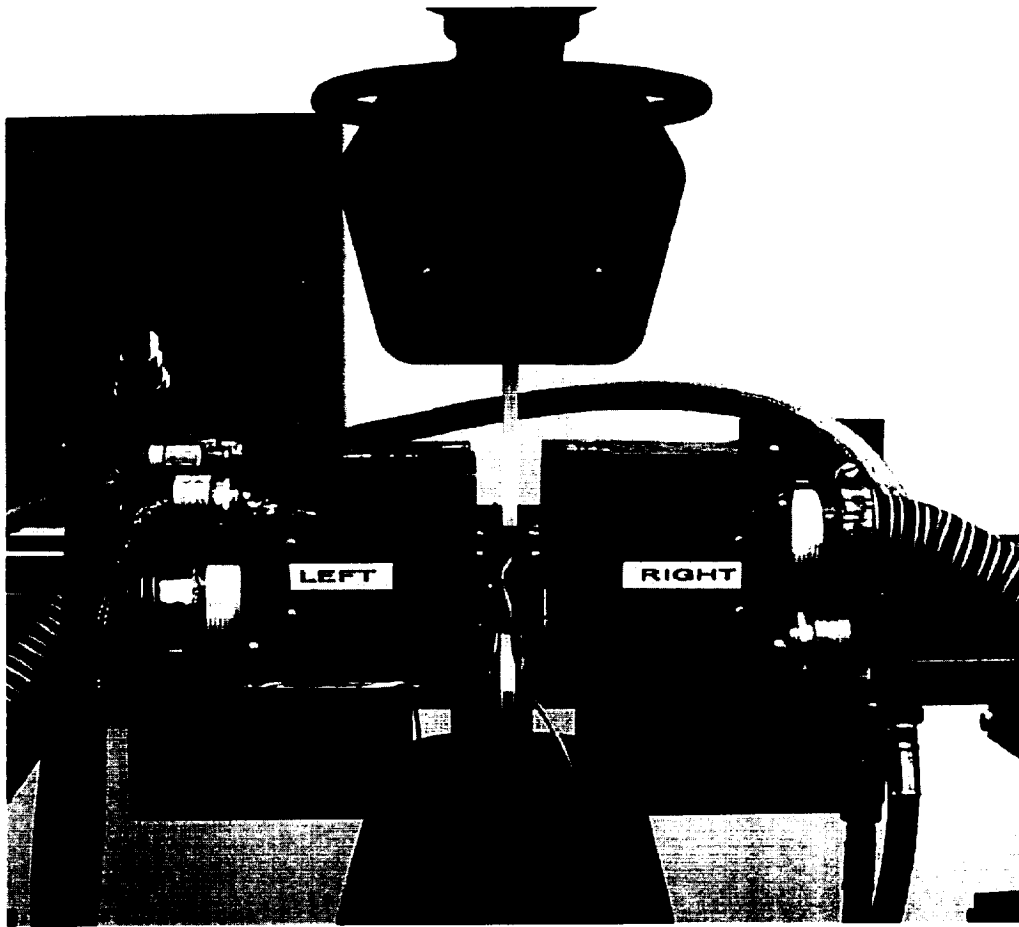


Figure 9. Tensile test with quartz lamp heaters.

3.4 In-Plane Shear Testing

The ASTM D 3518 in-plane shear test specimens were machined from an eight-ply ± 45 laminate. The in-plane shear specimens were heated and tested similarly to the tensile specimens with a 0.2 in./min loading rate. In addition to axial strain, an Epsilon, Inc. quartz arm, transverse extensometer was used to determine transverse strain. The transverse strain was required to obtain Poisson's ratio. Shear modulus could then be calculated from the equation $G_{12} = E_{xx} / (2 * (1 + \nu_{12}))$. Modulus and Poisson's ratio were obtained in the initial linear portion of the stress-strain diagram.

3.5 Compression Testing

Compression test specimens were machined in both the warp and fill directions from the same six-ply panels as the tension specimens. A modified ASTM D 695 fixture was fabricated which helped prevent end brooming of the test specimen. The specimen was loaded with steel anvils machined to the same thickness as the test specimen. The strain was obtained by modifying an Instron averaging axial extensometer. Testing was performed on an Instron 1125 test machine at a 0.05-in./min loading rate. Strain and load data were recorded on Instron Series IX software.

To heat the specimen following the thermal history profile of the CNC, high-resistance heater strips were placed against the specimen. The heater strips were composed of nikrothal. Copper was coated on the entire strip except for a 1.5-in. gauge in the center. Therefore, only the gauge area was heated. Mica is used to electrically insulate both the test fixture and test specimen. Figure 10 illustrates the compression test setup. When high current from a direct current power supply was passed through the nikrothal strip, heat was generated in the uncoated portion of the strip. This current was controlled with a Hewlett Packard power supply. A small change in current produced a small change in temperature. Thus, the thermal history profile was followed by altering the current.

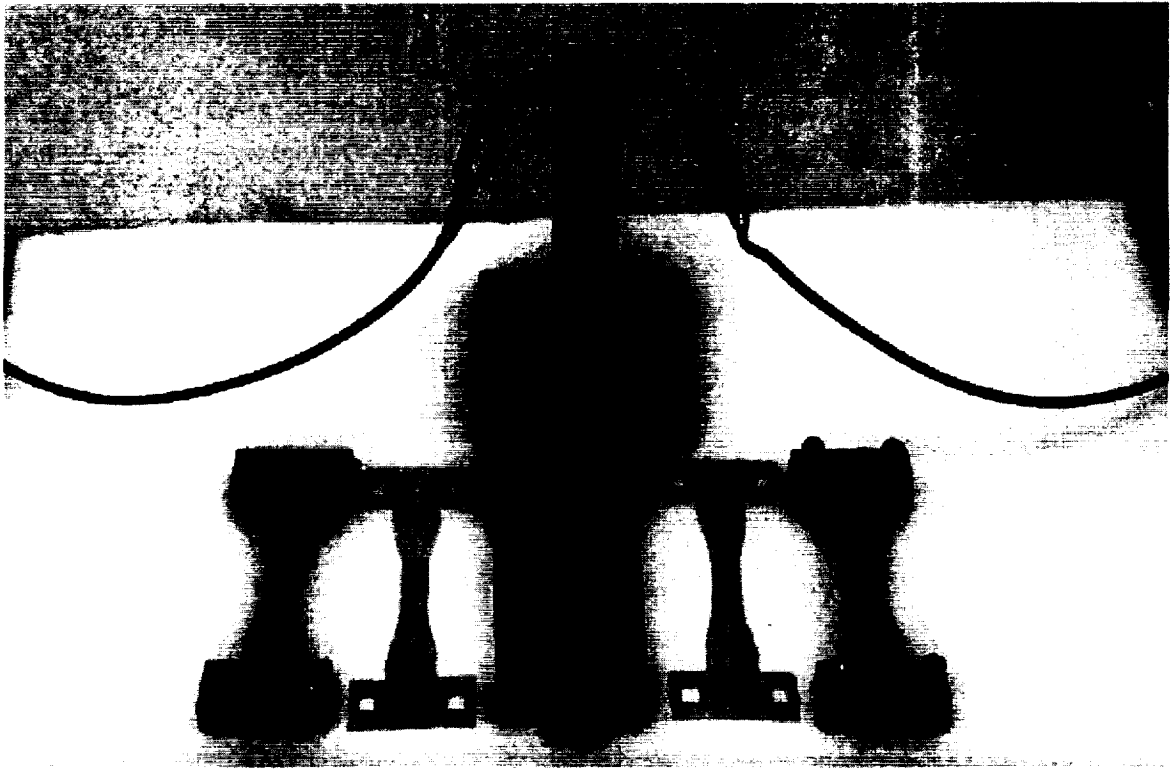


Figure 10. Compression test fixture with resistance heat strips.

3.6 Interlaminar Shear Testing

The ASTM D 3846 double-notch shear (DNS) specimens were machined from an eight-ply layup. Specimens were cut and tested in the warp direction. The DNS specimen is the same length and width as the compression specimen. This similar geometry allowed the DNS specimen to be tested in the same fixture as the compression specimen. The DNS specimen was also heated with the resistance strip heaters. The only data obtained from the DNS test were the failure loads. The failure load was divided by the area of the gauge section to obtain τ_{13} .

3.7 Core Testing

Compression, shear, and tensile properties were obtained on the syntactic foam core. ASTM C 365 was used to obtain compression stress of the foam. A 1×1 in. square was crushed between two steel platens. Failure load was recorded for each specimen. Shear stress was obtained from an ASTM D 732 shear punch specimen. Again, only the failure load was obtained. MTS extensometers were used to obtain strain on the ASTM D 638 edgewise tensile specimens. Thus, modulus and stress were determined for the tensile specimens.

As the core specimens were not moisture conditioned, a rapid heat rate was not required for testing. Thus, the elevated temperature compression and shear specimens were heated in an oven. Tensile specimens were tested utilizing the quartz lamp heaters. A slower heating rate was used for the core specimens than for the graphite/epoxy specimens.

3.8 Sandwich Tensile Testing

Mechanical testing was performed on the sandwich structure as a verification of processing as well as the stress model. The sandwich was composed of an outer facesheet of AS4/3501-6, a core of eight plies of SC350G syntactic foam, and an inner facesheet of AS4/3501-6. The inner and outer facesheets were each a seven-ply laminate with an orientation of (0/90/45/0/-45/90/0). The sandwich panels were processed with the same cure conditions as the flat panels. Sandwich samples were tested at room temperature and 350 °F. The double-lap shear tests included a set at 480 °F.

ASTM D 638 tensile samples were machined from the sandwich panels. Room-temperature specimens were instrumented with strain gauges and tested in the same manner as the core tensile specimens. Elevated temperature tests required the quartz lamp heaters and extensometers, as illustrated in figure 9. Tensile specimens machined from the prototype (P1) nose cap had a small curvature. The P1 samples were tested with the same mechanical wedge grips as the flat panels. The failure modes indicated that the curvature had no effect on the test. Failure loads were similar to the flat panels. Open-hole tensile tests were also performed in accordance with NASA Reference Publication 1092. The specimens were 2 in. wide with a 0.25-in.-diameter hole in the center of the sample.

ASTM C 364 compression samples were originally planned for use in evaluation of the strength of the sandwich. However, the Northrop compression test fixture was utilized instead. Thus, the compression test results could be compared more directly with the open-hole compression test results. The Northrop fixture requires a sample that is 1×3 in. The sample was supported on the edges

and end-loaded. Panels that were exposed to the environment at Kennedy Space Center for 6 mo were also compression tested. Postbeach exposure samples had the same strength as the control samples at room temperature. However, a small reduction in strength was observed at 350 °F. Specimens that were exposed to 8.6 Btu/ft²/sec for 34 sec and 4.5 Btu/ft²/sec for 40 sec in the Improved Hot Gas Facility (IHGF) were also compression tested. Reductions in strength were observed at both room temperature and 350 °F. Open-hole compression specimens had the same dimensions as a compression specimen with the addition of a 0.25-in.-diameter hole in the center of the specimen. Open-hole compression specimens were tested in the same manner as the compression specimens. Compression specimens cut from the P1 had the same curvature as the tensile specimens. P1 compression strengths were similar to the flat panels.

Compression after impact (CAI) tests were performed on the sandwich material. Sandwich panels were cut into 4×6 in. samples. The samples were impacted with a falling dart with a 0.5-in. hemispherical tip. Impact energy levels included 5, 10, 20, and 30 ft-lb with a control set of samples that were not impacted. After impact, the samples were compression tested in the Boeing CAI test fixture. An increasing decline in strength was observed until the residual strength reached a minimum at the 20 ft-lb energy level (see fig. 25 in app. A).

Double- and single-lap shear tests were performed on the sandwich material in accordance with ASTM D 953 and MIL-HDBK-17-1e, respectively. Tests were performed in the 0° and 45° orientations at room temperature, 350 °F, and 480 °F. The sandwich test results are available in table 6. Detailed test results are available in table 8 of appendix B.

4. SOUTHERN RESEARCH INSTITUTE CORRELATION STUDY

To evaluate the MSFC High Temperature Test Facility, lot 1 AS4/3501–6/370–8H material was divided into two sets. Southern Research Institute (SRI) tested one set with MSFC testing the other set. Both sets were conditioned at 180 °F, 93-percent RH for 10 days prior to testing. Both facilities performed tension, compression, in-plane shear, and interlaminar shear tests at four different temperatures. A test readiness review was conducted to review the results of lot 1 testing. Test results correlated well between the two facilities. Some deviations in test results were observed at certain test conditions, and actions were taken to compare testing and results between the two facilities. MSFC performed additional tests with slight modifications to the test procedure to evaluate the discrepancies. Reevaluation of resulting data showed the MSFC test results to be valid. Tables 2–5 summarize the results of the correlation study, and also displays the results of the retests. Due to a “hot spot” generated on the first set of 240 °F tensile and in-plane shear specimens, the results from the retest will be used in the database. The other change in the test procedure was the use of a 1-in. extensometer rather than a 2-in. extensometer to minimize the temperature gradient across the test specimen.

Table 2. AS4/3501-6 8H lot 1 tensile.

Tensile Warp

Temperature (°F)		MSFC Stress (ksi)	MSFC Retest	SRI Stress	MSFC E ₁₁ (Msi)	MSFC Retest	SRI E ₁₁
75	Average	111.2	—	100.7	10.0	—	9.3
	Std. Dev.	3.4	—	3.7	0.4	—	0.6
	N	12	—	3	12	—	3
240	Average	93.1	106.0	90.4	8.6	9.6	8.3
	Std. Dev.	7.5	4.7	2.1	1.0	0.3	0.4
	N	5	6	4	5	6	4
550	Average	69.7	72.1**	—	5.8	5.8**	—
	Std. Dev.	4.7	3.1	—	0.8	0.3	—
	N	6	12	—	6	12	—
600	Average	—	—	63.1	—	—	3.4
	Std. Dev.	—	—	6.5	—	—	0.3
	N	91.8	—	5	—	—	6
350*	Average	3.1	95.5**	94.6	8.0	8.2**	7.7
	Std. Dev.	6	8.9	2.6	0.5	1.0	0.8
	N	—	21	3	6	15	3

**Lot 2

Tensile Fill

Temperature (°F)		MSFC Stress (ksi)	MSFC Retest	SRI Stress	MSFC E ₂₂ (Msi)	MSFC Retest	SRI E ₂₂
75	Average	106.2	—	103.2	9.7	—	9.2
	Std. Dev.	5.0	—	3.6	0.4	—	0.4
	N	6	—	6	6	—	6
240	Average	90.1	105.5	—	8.4	9.7	—
	Std. Dev.	6.7	3.4	—	0.8	0.5	—
	N	12	8	—	12	8	—
550	Average	64.4	—	—	5.7	—	—
	Std. Dev.	6.5	—	—	1.2	—	—
	N	11	—	—	12	—	—
350*	Average	96.3	—	—	8.8	—	—
	Std. Dev.	6.0	—	—	0.5	—	—
	N	12	—	—	12	—	—

Table 3. AS4/3501–6 8H lot 1 compression.

Compression Warp

Temperature (°F)		MSFC Stress (ksi)	MSFC Retest	SRI Stress	MSFC E ₁₁ (Msi)	MSFC Retest	SRI E ₁₁
75	Average	78.2	–	76.4	8.4	–	9.0
	Std. Dev.	8.1	–	6.2	0.3	–	0.3
	N	6	–	7	6	–	7
240	Average	43.2	40.4	54.8	8.0	7.9	8.4
	Std. Dev.	6.9	5.0	5.5	0.9	0.6	0.3
	N	6	6	6	6	6	6
600	Average	3.7	3.7	5.3	–	2.3	6.6
	Std. Dev.	0.5	0.5	0.4	–	0.7	0.7
	N	6	6	6	–	6	6
350*	Average	25.1	–	26.9	6.7	–	8.1
	Std. Dev.	3.1	–	2.3	0.7	–	0.4
	N	5	–	6	3	–	6

Compression Fill

Temperature (°F)		MSFC Stress (ksi)	MSFC Retest	SRI Stress	MSFC E ₂₂ (Msi)	MSFC Retest	SRI E ₂₂
75	Average	79.7	–	84.4	8.7	–	9.1
	Std. Dev.	4.4	–	7.1	1.0	–	0.2
	N	6	–	6	6	–	6
240	Average	39.5	40.2	55.3	8.3	7.6	8.7
	Std. Dev.	10.8	5.3	2.7	0.8	0.7	0.3
	N	6	6	6	6	6	6
600	Average	4.4	4.4	5.6	–	1.3	6.5
	Std. Dev.	0.2	0.2	0.5	–	0.7	0.5
	N	6	6	7	–	6	7
350*	Average	24.1	–	29.3	7.9	–	8.1
	Std. Dev.	2.6	–	2.0	0.7	–	0.3
	N	4	–	3	4	–	3

Table 4. AS4/3501–6 8H lot 1 shear.

In-plane shear

Temperature (°F)		MSFC τ_{12} (ksi)	MSFC Retest	SRI τ_{12}	MSFC E_{xx} (ksi)	MSFC Retest	SRI E_{xx}	MSFC G_{12} (ksi)	MSFC Retest	SRI G_{12}
75	Average	12.0	–	11.9	2720	–	2490	754	–	710
	Std. Dev.	0.2	–	0.5	151	–	120	41	–	40
	N	6	–	6	6	–	6	5	–	6
240	Average	6.2	7.9	7.7	517	1752	1590	144	467	440
	Std. Dev.	1.0	0.7	0.7	78	211	140	11	42	40
	N	6	6	5	6	6	4	5	6	4
550	Average	0.65	0.74	–	90	124	–	22	30	–
	Std. Dev.	0.06	0.12	–	7	19	–	2	6	–
	N	6	6	–	6	6	–	5	6	–
600	Average	–	–	0.65	–	–	81	–	–	–
	Std. Dev.	–	–	0.06	–	–	24	–	–	–
	N	–	–	5	–	–	5	–	–	–
350*	Average	3.7	2.8	8.1	501	484	520	119	141	–
	Std. Dev.	0.5	0.7	0.8	149	197	28	39	48	–
	N	6	6	2	6	6	2	6	6	–

Table 5. AS4/3501–6 8H lot 1 DNS.

Temperature (°F)		MSFC τ_{13} (ksi)	SRI τ_{13}
75	Average	6.8	5.2
	Std. Dev.	0.5	0.3
	N	6	6
240	Average	4.3	4.5
	Std. Dev.	0.6	0.5
	N	6	6
600	Average	0.20	0.21
	Std. Dev.	0.02	0.04
	N	5	5
350*	Average	1.5	1.1
	Std. Dev.	0.3	0.1
	N	5	5

5. TEST RESULTS

After completion of the TRR, testing commenced on lots 2 and 3. The only major anomaly associated with subsequent testing was a high variability in tensile test results for lot 2. Large deviations in strength and modulus were observed between different panels tested under the same conditions. Failed specimens were dissected ply by ply. A high degree of fill misalignment was observed in the dissected specimens. This misalignment was also observed in the prepreg of lot 2. Some specimens had a misalignment as high as 6° on as many as half the plies. The misalignment had no apparent effect on compression or shear test specimens. However, the high-temperature tensile fill specimens were affected by the misalignment. Previous test results suggest that the warp and fill properties are the same when there is no misalignment.

A summary of lamina level testing with A-basis values is shown in table 6. The 350* designates refer to samples that were initially heated to 600 °F, then cooled to 350 °F. Test results that compare lots 1–3 and chart the properties versus temperature are available in appendix A. A detailed summary of the raw data is available in appendix B.

Table 6. Lamina level tests (AS/3501–6), core tests SC350G, and sandwich tests.

Lamina Level Tests (AS4/3501–6)		75 °F	75 °F	240 °F	240 °F	350 °F*	350 °F*	550 °F	550 °F	350 °F	480 °F
Orientation	Property	Average	A-Basis	Average	A-Basis	Average	A-Basis	Average	A-Basis	Average	Average
Warp	Tensile stress (ksi)	111.6	98.0	110.6	97.3	93.9	61.6	74.8	54.1	100.5	74.6
Fill	Tensile stress (ksi)	104.6	75.6	102.8	68.4	80.2	26.8	57.3	17.2	84.4	71.7
Warp	Compr. stress (ksi)	82.9	59.8	38.9	23.9	22.6	10.2	4.2	2.3	12.5	5.2
Fill	Compr. stress (ksi)	82.3	65.4	40.9	25.4	22.7	11.4	4.3	3.1	11.6	5.7
45	In-Plane shear (ksi)	13.3	10.4	7.8	4.8	3.15 **	0.63 **	0.80	0.43	1.77	0.92
Warp	Interlaminar shear (psi)	7040	5131	4004	2904	1593	685	195	76	954	335
Warp	Poisson's ratio	0.06									
Fill	Poisson's ratio	0.07									

Lamina Level Tests (AS4/3501–6)		75 °F	75 °F	240 °F	240 °F	350 °F	350 °F	600 °F	600 °F	350 °F	480 °F
Orientation	Property	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Average
Warp	Tensile modulus (Msi)	9.8	0.4	8.6	1.8	7.2	1.6	5.0	1.1	7.4	5.5
Fill	Tensile modulus (Msi)	9.7	0.4	7.9	1.9	6.3	2.5	4.3	1.7	7.2	6.6
Warp	Compr. modulus (Msi)	8.7	0.7	7.8	1.3	5.2	1.7	1.8	0.8	6.5	3.0
Fill	Compr. modulus (Msi)	8.7	0.6	8.0	1.2	4.6	1.0	1.8	0.7	6.1	2.9
45	Shear modulus (ksi)	730.5	56.0	467.5	84.3	113.2 **	75.8 **	48.0	22.2	61.6	44.2

Core Tests (SC350G)		75 °F	75 °F	350 °F	350 °F	480 °F	480 °F
Orientation	Property	Average	A-Basis	Average	A-Basis	Average	A-Basis
x	Tensile stress (psi)	3678	2399	2470	1083	1202	489
x	Tensile modulus (ksi)	416	–	260	–	112	–
z	Flatwise compr. (psi)	9798	8351	6009	3791	1875	979
zx	Shear punch (psi)	4463	3395	2845	2234	763	654

Sandwich Tensile Tests		75 °F	75 °F	350 °F	350 °F	Prototype 1		Prototype 1	
Orientation	Property	Average	Std. Dev.	Average	Std. Dev.	75 °F	75 °F	350 °F	350 °F
0	Tensile Load (lb/in.)	17093	442	15387	1788	16558	933	10985	2 tests
45	Tensile Load (lb/in.)	11440	439	9353	1040				
0	Load/(W*e) (kips/in.)	1726	51	1494	352	1622	73		
45	Load/(W*e) (kips/in.)	1083	25	760	152				
0	Open hole (2"x0.25" Hole) (lb)	21625	778	22225	980				
z	Flatwise tension (psi)	2164	306	894	128				

Sandwich Compression Tests		75 °F	75 °F	350 °F	350 °F	Prototype 1		Prototype 1	
Orientation	Property	Average	Std. Dev.	Average	Std. Dev.	75 °F	75 °F	350 °F	350 °F
0	Compr. Load (lb/in.)	16955	1724	10386	1228	15163	2290	10430	2 tests
45	Compr. Load (lb/in.)	14857	1387	8473	984				
0	Load/(W*e)(kips/in.)	1552	87			1580	114		
45	Load/(W*e)(kips/in.)	1055	47						
0	Post IHGF Comp (lb/in.)	14824	1051	9585	1609				
0	Post beach Comp (lb/in.)	16929	1312	8993	1008				
0	Open-Hole (1"x0.25" hole)(lb)	10605	214	6665	362				

Double-Lap Shear (Bearing)		75 °F	75 °F	350 °F	350 °F	480 °F	480 °F
Orientation	Property	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
0	Ultimate bearing (lb)	6514	267	3616	271	2093	370
0	Load/disp (lb/in.)	510408	91191				
45	Ultimate bearing (lb)	6437	244	3503	301	2093	273
45	Load/disp (lb/in.)	425364	61545	54002	2006		

Single-Lap Shear (Bearing)		75 °F	75 °F
Orientation	Property	Average	Std. Dev.
0	Ultimate bearing (lb)	9208	719
45	Ultimate bearing (lb)	8597	245

Compression After Impact		75 °F	75 °F	350 °F	350 °F
Orientation	Property	Average	Std. Dev.	Average	Std. Dev.
0	Load (lb) 0 ft-lb	68513	2302	31828	2761
0	Load (lb) 10 ft-lb	41477	2244	29056	2022
0	Load (lb) 20 ft-lb	33093	1473	23613	341
0	Load (lb) 30 ft-lb	32230	1236	24650	1541

* Flight profile

** Two lots

6. CONCLUSIONS

The test standards chosen produced satisfactory failure modes. The correlation study performed with SRI indicated that the test methodology was sound. The weight gains of the moisture conditioned test specimens matched the predicted weight gains. Therefore, the moisture absorption characteristics of the composite were adequately identified. Due to the conservative estimates of the beach environment, subsequent beach exposure panels gained less weight than the mechanical property test specimens. Thus, the moisture exposure of 10 days at 180 °F, 93-percent RH was sufficient. There was too much scatter in the data to conclude that every data set was within the same population. However, one-sided analysis of variation statistics suggested the three lots of material were within the same population in several of the data sets. Further statistical evaluation should be performed to determine lot-to-lot variability. A-basis allowables were generated for the two materials at each of the required temperature conditions.

APPENDIX A—A COMPARISON OF LOTS 1–3 CHARTING THE PROPERTIES VERSUS TEMPERATURE

Table 7 and figures 11–24 show test results that compare lots 1–3 and chart the properties versus temperature.

Table 7. Various test results for lots 1–3.

ASTM D 695 AS4/3501–6 8H									
Compression Warp		Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3		
Temperature (°F)		Stress (ksi)	Stress (ksi)	Stress (ksi)	E ₁₁ (Msi)	E ₁₁ (Msi)	E ₁₁ (Msi)		
75	Average	78.2	85.7	79.9	8.4	9.0	8.2		
	Std. Dev.	8.1	10.6	4.0	0.3	0.7	0.6		
	COV	10.4	12.3	5.0	3.6	7.5	7.3		
	N	6	11	12	6	8	12		
240	Average	43.2	41.2	35.9	8.0	7.7	7.9		
	Std. Dev.	6.9	4.8	4.0	0.9	0.9	1.9		
	COV	15.9	11.7	11.0	11.0	11.6	23.5		
	N	6	12	12	6	11	12		
600	Average	3.7	3.8	4.8	2.3	1.2	2.0		
	Std. Dev.	0.5	0.3	0.2	0.7	0.7	0.5		
	COV	14.5	7.7	4.9	31.3	59.8	26.4		
	N	6	12	12	6	11	12		
350*	Average	25.0	18.4	24.5	6.4	3.8	5.7		
	Std. Dev.	2.7	4.0	1.6	0.8	1.9	0.8		
	COV	10.6	21.7	6.7	12.6	49.4	14.5		
	N	12	12	12	10	12	12		
350	Average	12.5	–	–	6.5	–	–		
	Std. Dev.	2.1	–	–	1.6	–	–		
	COV	16.9	–	–	24.1	–	–		
	N	8	–	–	8	–	–		
480	Average	5.2	–	–	3.0	–	–		
	Std. Dev.	0.3	–	–	0.5	–	–		
	COV	6.6	–	–	17.7	–	–		
	N	8	–	–	8	–	–		

Compression Fill									
		Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3		
Temperature (°F)		Stress (ksi)	Stress (ksi)	Stress (ksi)	E ₁₁ (Msi)	E ₁₁ (Msi)	E ₁₁ (Msi)		
75	Average	79.7	83.9	82.0	8.7	9.0	8.5		
	Std. Dev.	4.4	5.9	5.5	1.1	0.3	0.5		
	COV	5.6	7.0	6.7	12.2	3.5	5.7		
	N	6	12	12	6	12	12		
240	Average	39.5	44.9	37.3	8.3	8.4	7.8		
	Std. Dev.	10.8	4.4	2.6	0.9	0.6	1.8		
	COV	27.3	9.8	7.0	10.5	7.5	22.9		
	N	6	12	12	6	12	12		
600	Average	4.4	3.9	4.6	1.3	2.0	1.9		
	Std. Dev.	0.2	0.3	0.2	0.7	0.7	0.6		
	COV	5.1	6.7	4.8	55.1	33.8	32.2		
	N	6	12	12	6	12	12		
350*	Average	23.9	18.4	25.9	4.2	4.9	4.5		
	Std. Dev.	2.0	2.6	1.5	1.0	0.9	0.9		
	COV	8.5	14.2	5.6	24.0	17.4	20.3		
	N	12	12	12	10	12	12		
350	Average	11.8	–	–	6.1	–	–		
	Std. Dev.	1.1	–	–	1.5	–	–		
	COV	9.4	–	–	25.0	–	–		
	N	8	–	–	8	–	–		
480	Average	5.7	–	–	2.9	–	–		
	Std. Dev.	0.4	–	–	0.5	–	–		
	COV	7.4	–	–	16.8	–	–		
	N	8	–	–	8	–	–		

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Tensile Warp

		Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3
Temperature (°F)		Stress (ksi)	Stress (ksi)	Stress (ksi)	E ₁₁ (Msi)	E ₁₁ (Msi)	E ₁₁ (Msi)
75	Average	111.2	112.6	110.9	10	9.8	9.6
	Std. Dev.	3.4	6.5	3.1	0.38	0.05	0.3
	COV	3.1	5.8	2.8	3.8	0.5	3.0
	N	12	12	12	12	12	11
240	Average	106.0	113.2	110.2	9.6	9.7	6.9
	Std. Dev.	4.7	3.12	3.3	0.3	1.3	1.4
	COV	4.4	2.8	3.0	3.1	13.4	20.2
	N	6	12	12	6	12	12
550	Average	69.7	72.1	80.2	5.8	5.8	3.9
	Std. Dev.	4.7	3.1	6.8	0.8	0.3	0.4
	COV	6.7	4.3	8.5	13.8	5.2	9.3
	N	6	12	12	6	12	12
350*	Average	91.8	95.5	92.3	8	8.2	5.7
	Std. Dev.	3.1	8.9	18	0.5	1	1.1
	COV	3.4	9.3	19.5	6.3	12.2	19.3
	N	6	21	12	6	15	12
350	Average	100.5	—	—	7.4	—	—
	Std. Dev.	4.0	—	—	0.4	—	—
	COV	4.0	—	—	4.9	—	—
	N	8	—	—	8	—	—
480	Average	74.6	—	—	5.5	—	—
	Std. Dev.	7.0	—	—	0.8	—	—
	COV	9.4	—	—	13.8	—	—
	N	8	—	—	8	—	—

Tensile Fill

		Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3
Temperature (°F)		Stress (ksi)	Stress (ksi)	Stress (ksi)	E ₁₁ (Msi)	E ₁₁ (Msi)	E ₁₁ (Msi)
75	Average	106.2	102.9	105.5	9.7	9.7	9.6
	Std. Dev.	5	12	8.7	0.4	0.6	0.3
	COV	4.7	11.7	8.2	4.1	6.2	3.6
	N	6	12	12	6	12	12
240	Average	105.5	96.6	107.3	9.7	6.6	7.9
	Std. Dev.	3.4	13.5	10.2	0.5	1.4	1.9
	COV	3.2	14.0	9.5	5.2	21.2	23.9
	N	8	12	12	8	12	11
550	Average	64.4	50.9	57.3	5.7	4.1	2.5
	Std. Dev.	6.5	12.2	16.5	1.2	1.0	1.2
	COV	10.1	24.0	28.8	21.1	24.4	48.0
	N	11	12	12	12	12	9
350*	Average	96.3	81.2	64.5	8.8	6.6	3.9
	Std. Dev.	6	14.5	13.9	0.5	1.8	1.5
	COV	6.2	17.9	21.6	5.7	27.3	38.5
	N	11	11	12	11	8	12
350	Average	84.4	—	—	7.19	—	—
	Std. Dev.	6.5	—	—	1.03	—	—
	COV	7.7	—	—	14.3	—	—
	N	8	—	—	8	—	—
480	Average	71.7	—	—	6.6	—	—
	Std. Dev.	8.5	—	—	1.0	—	—
	COV	11.9	—	—	15.8	—	—
	N	8	—	—	8	—	—

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In-Plane Shear		Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3
Temperature (°F)		τ_{12} (ksi)	τ_{12} (ksi)	τ_{12} (ksi)	G_{12} (ksi)	G_{12} (ksi)	G_{12} (ksi)
75	Average	12	13.4	13.8	754	770	683
	Std. Dev.	0.2	0.8	0.7	41	45	23
	COV	1.7	6.0	4.8	5.4	5.8	3.4
	N	6	12	12	5	11	12
240	Average	7.9	7.7	7.9	467	417	529
	Std. Dev.	0.7	0.9	1.2	42	75	81
	COV	8.9	11.7	15.8	9.0	18.0	15.2
	N	6	12	11	6	12	9
550	Average	0.69	0.79	0.93	26.4	40.0	76.1
	Std. Dev.	0.10	0.03	0.06	6.1	7.0	7.0
	COV	14.6	4.1	5.9	23.0	17.5	9.2
	N	12	12	12	11	12	12
350*	Average	3.3	3.0	6.3	129.7	95	242
	Std. Dev.	0.7	0.8	0.6	43.2	21	59
	COV	21.2	26.7	9.9	33.3	22.1	24.6
	N	11	12	12	12	12	12
350	Average	1.8	–	–	62.6	–	–
	Std. Dev.	0.6	–	–	20.2	–	–
	COV	33.9	–	–	32.3	–	–
	N	7	–	–	7	–	–
480	Average	0.92	–	–	44.2	–	–
	Std. Dev.	0.03	–	–	3.7	–	–
	COV	3.7	–	–	8.4	–	–
	N	8	–	–	7	–	–

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Double Notch Shear		Lot 1	Lot 2	Lot 3
Temperature (°F)		τ_{13} (ksi)	τ_{13} (ksi)	τ_{13} (ksi)
75	Average	6.84	6.99	7.19
	Std. Dev.	0.47	0.57	0.62
	COV	6.8	8.1	8.7
	N	6	12	12
240	Average	4.29	3.83	4.03
	Std. Dev.	0.46	0.23	0.30
	COV	10.8	5.9	7.5
	N	6	12	12
600	Average	0.20	0.21	0.18
	Std. Dev.	0.02	0.03	0.05
	COV	9.9	13.5	27.0
	N	5	12	12
350*	Average	1.46	1.74	1.50
	Std. Dev.	0.25	0.29	0.30
	COV	17.1	16.6	19.7
	N	5	12	12
350	Average	0.95	–	–
	Std. Dev.	0.07	–	–
	COV	6.8	–	–
	N	6	–	–
480	Average	0.34	–	–
	Std. Dev.	0.03	–	–
	COV	9.1	–	–
	N	6	–	–

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Tensile		Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3
Temperature (°F)		Stress (psi)	Stress (psi)	Stress (psi)	E ₁₁ (ksi)	E ₁₁ (ksi)	E ₁₁ (ksi)
75	Average	3,771	3,557	3,705	414	445	388
	Std. Dev.	386	438	467	13	12	11
	COV	10.2	12.3	12.6	3.2	2.7	2.8
	N	12	12	12	12	12	12
350	Average	2,563	2,561	2,287	334	283	164
	Std. Dev.	471	496	407	121	64	29
	COV	18.4	19.4	17.8	36.3	22.6	17.9
	N	12	12	12	6	12	12
480	Average	1,124	1,248	1,229	103	111	121
	Std. Dev.	199	267	242	17	21	21
	COV	17.7	21.4	19.7	16.2	18.6	17.3
	N	12	12	12	11	12	12

ASTM C 365 SC350G

Compression		Lot 1	Lot 2	Lot 3
Temperature (°F)		Stress (ksi)	Stress (ksi)	Stress (ksi)
75	Average	10.4	9.6	9.4
	Std. Dev.	0.3	0.3	0.2
	COV	2.7	2.9	2.4
	N	12	12	12
350	Average	6.7	5.8	5.5
	Std. Dev.	0.9	0.2	0.1
	COV	13.8	2.9	1.7
	N	12	12	12
480	Average	1.7	1.7	2.2
	Std. Dev.	0.05	0.2	0.3
	COV	2.9	9.3	11.8
	N	12	12	12

ASTM D 732 SC350G

Shear Punch		Lot 1	Lot 2	Lot 3
Temperature (°F)		Stress (psi)	Stress (psi)	Stress (psi)
75	Average	4,709	4,542	4,136
	Std. Dev.	173	206	382
	COV	3.7	4.5	9.2
	N	12	12	12
350	Average	2,978	2,884	2,674
	Std. Dev.	115	141	218
	COV	3.9	4.9	8.1
	N	12	12	12
480	Average	739	760	790
	Std. Dev.	27	33	32
	COV	3.7	4.4	4.0
	N	12	12	12

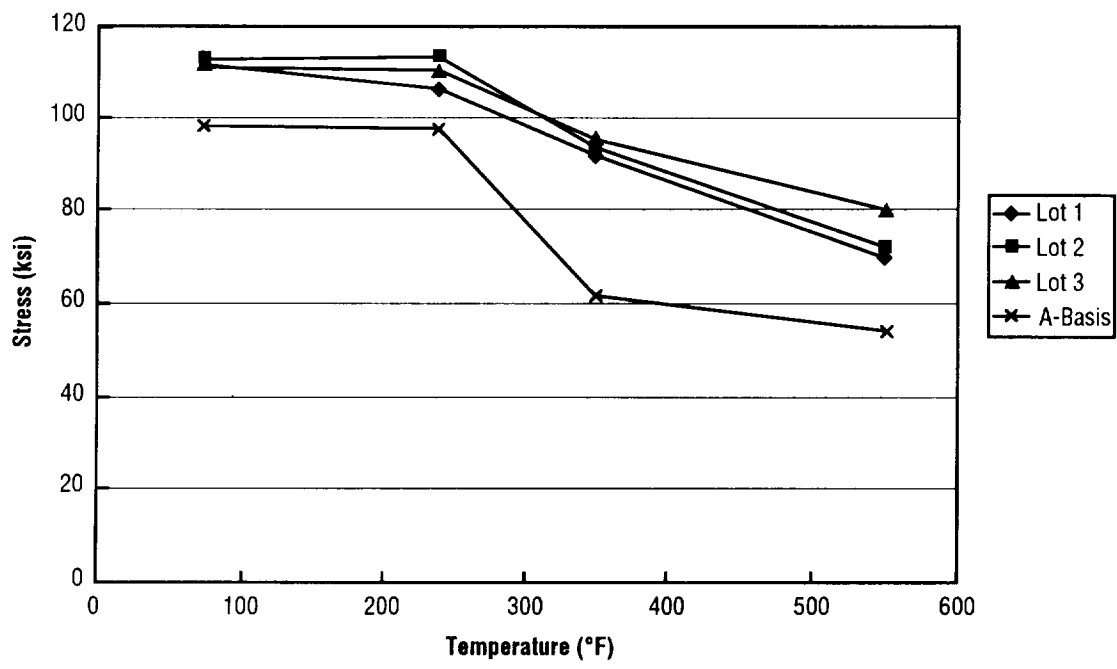


Figure 11. Tensile stress (warp).

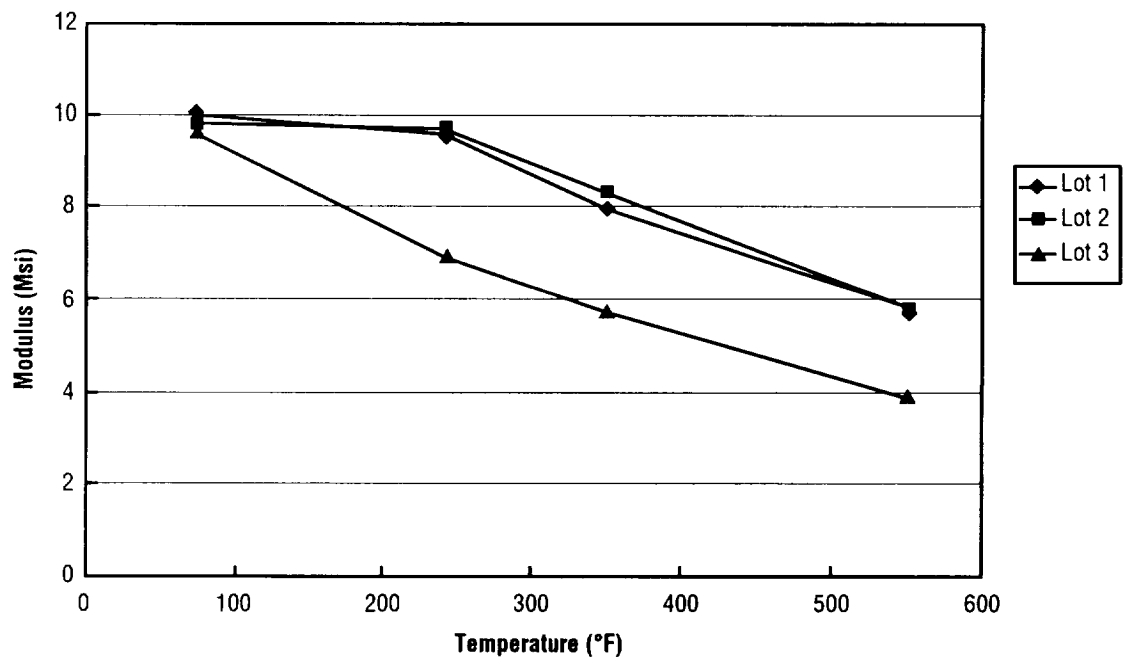


Figure 12. Tensile modulus (warp).

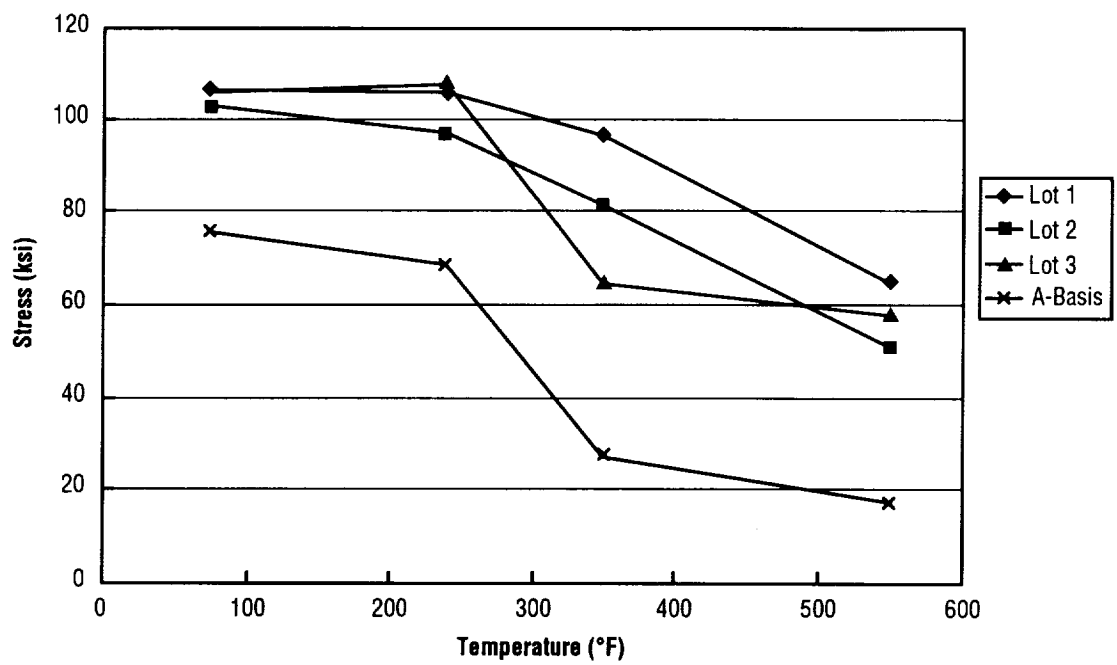


Figure 13. Tensile stress (fill).

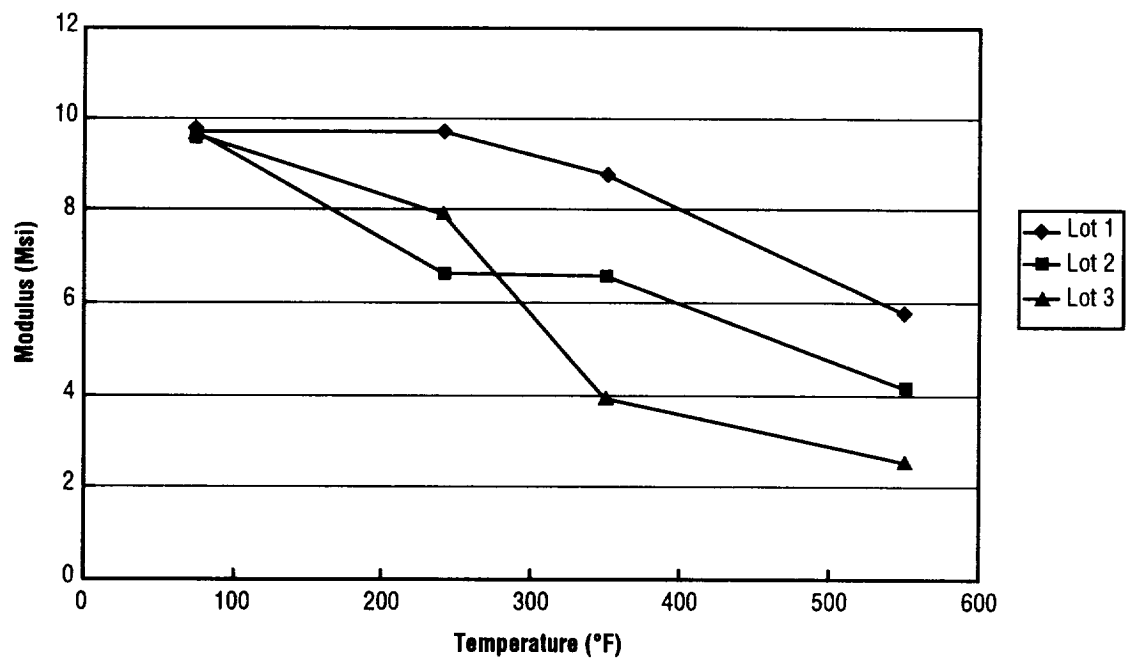


Figure 14. Tensile modulus (fill).

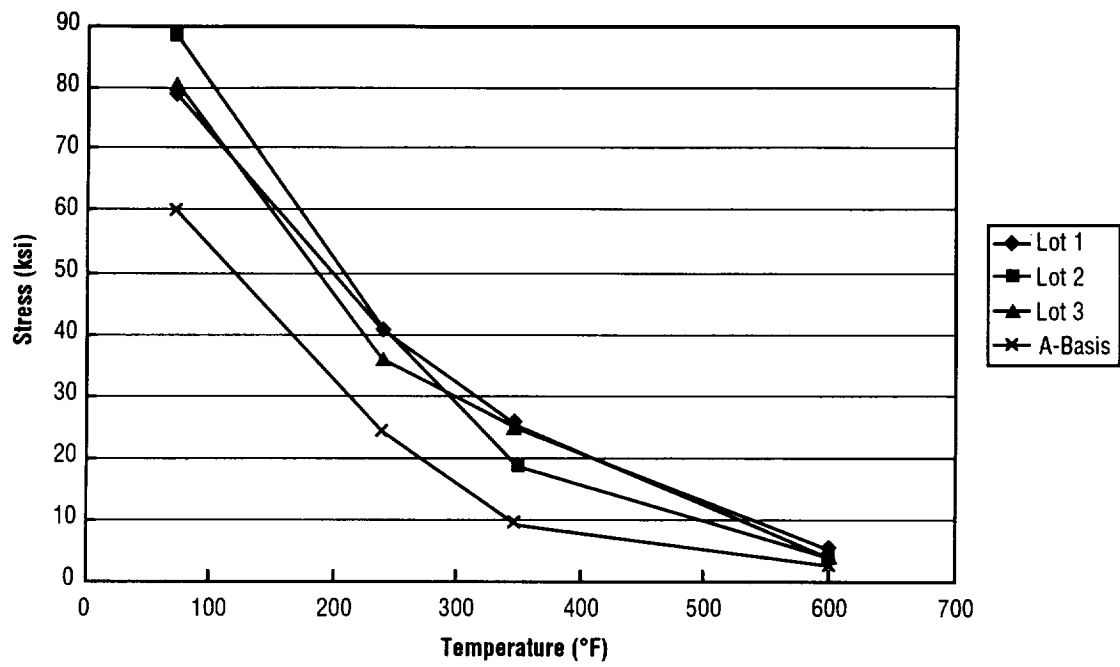


Figure 15. Compressive stress (warp).

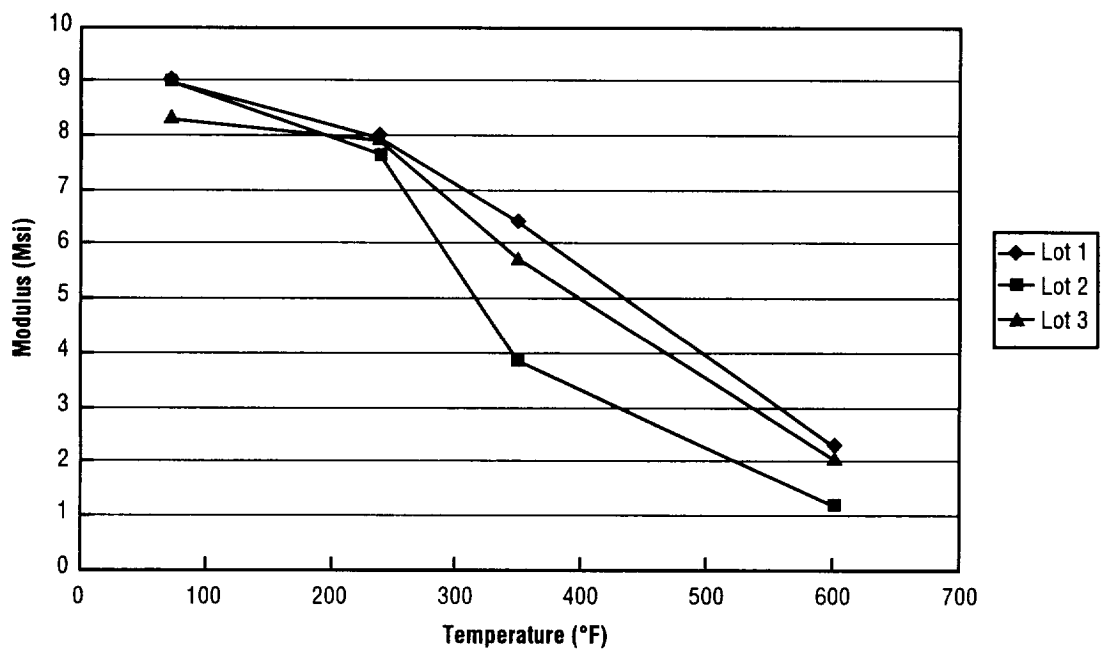


Figure 16. Compressive modulus (warp).

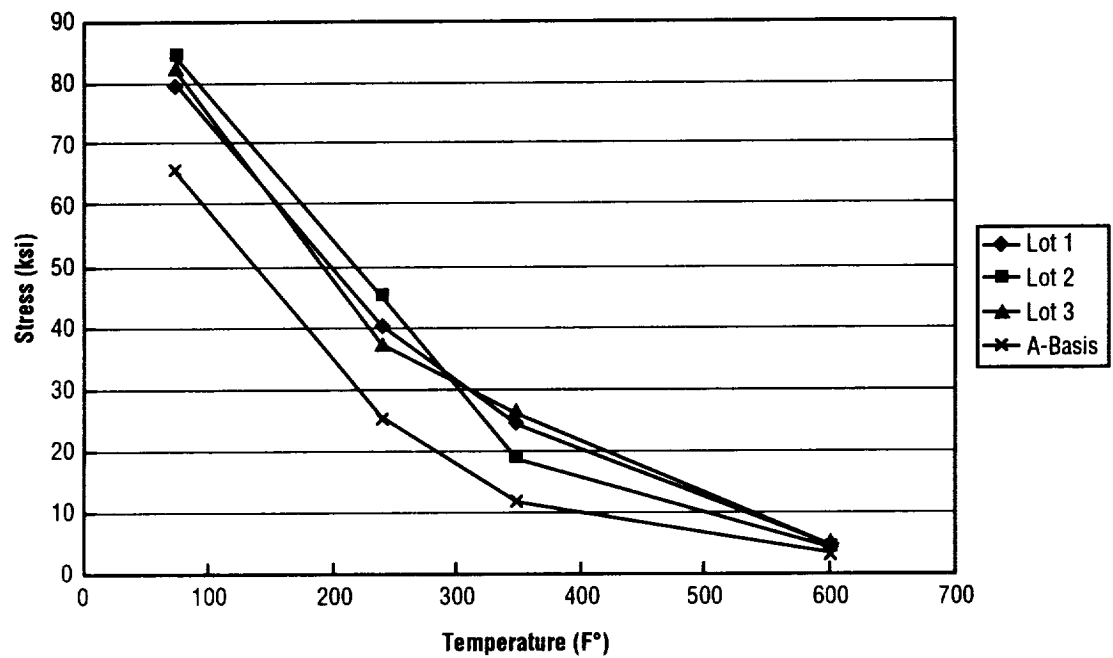


Figure 17. Compressive stress (fill).

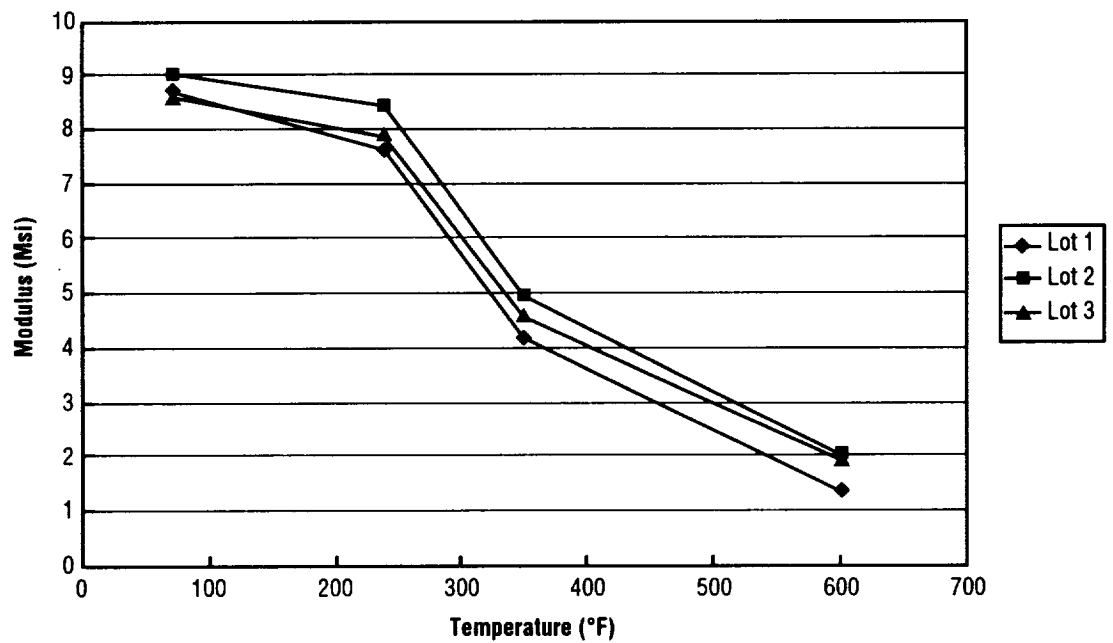


Figure 18. Compressive modulus (fill).

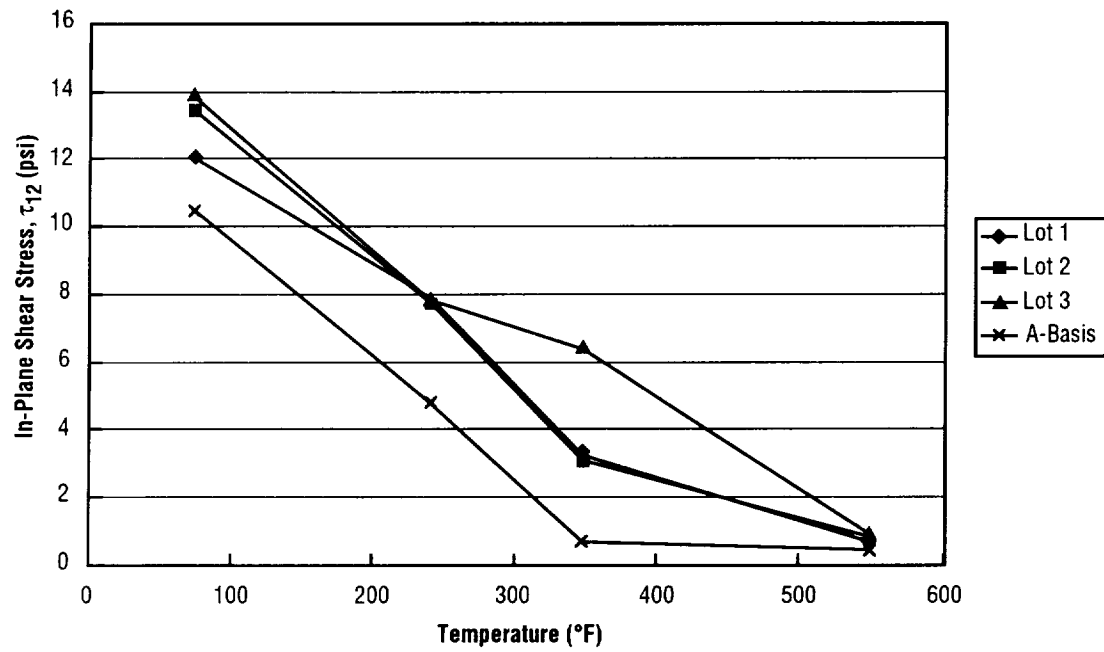


Figure 19. In-plane shear stress (τ_{12}).

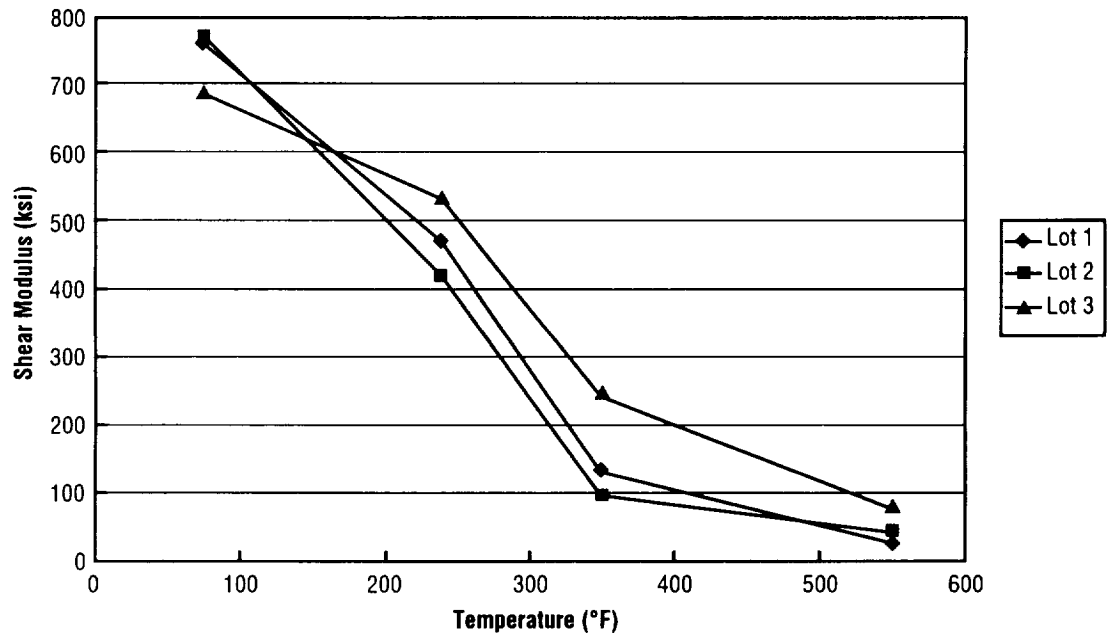


Figure 20. Shear modulus.

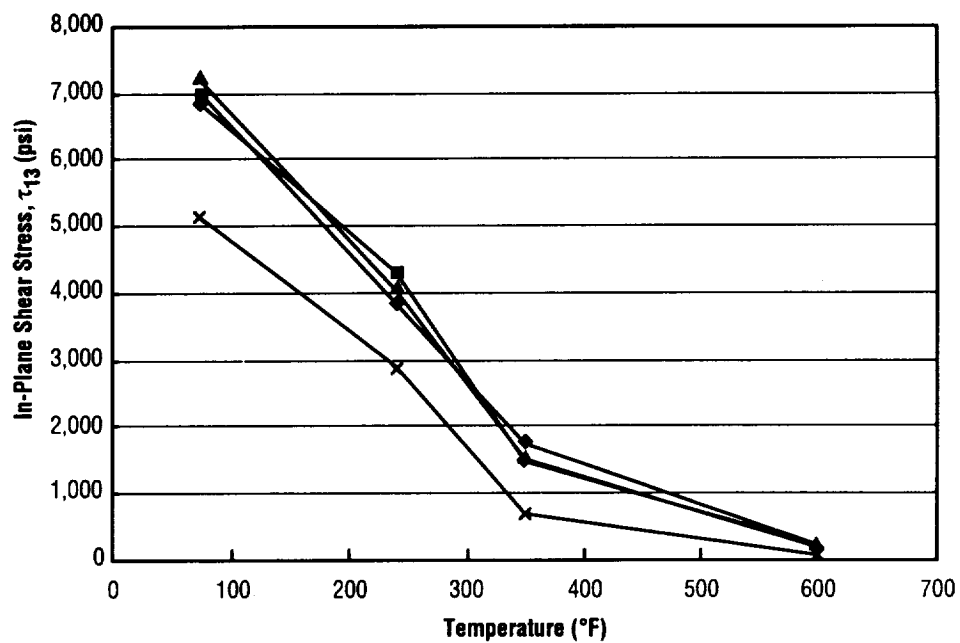


Figure 21. Double-notch shear (τ_{13}).

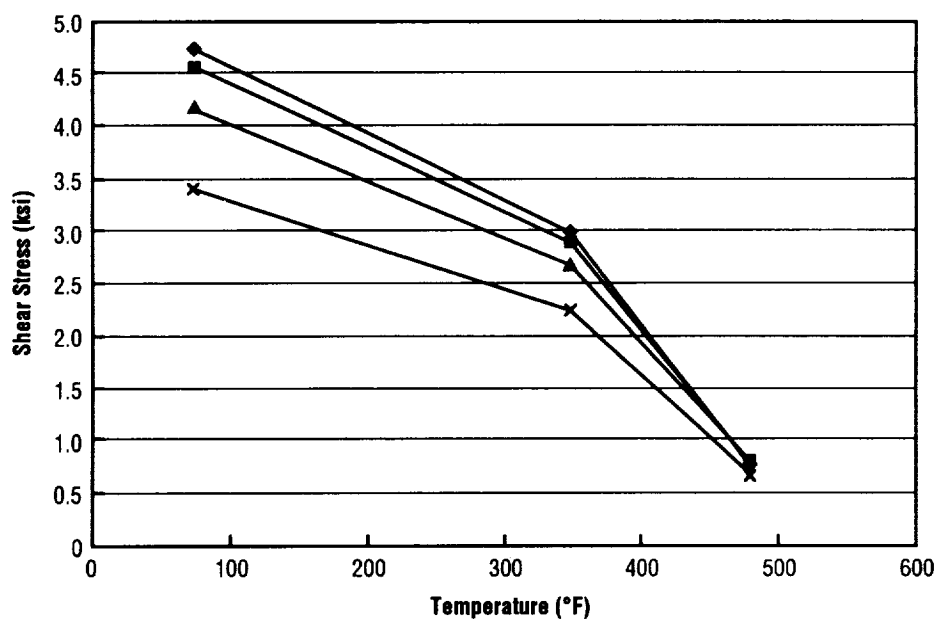


Figure 22. Foam shear.

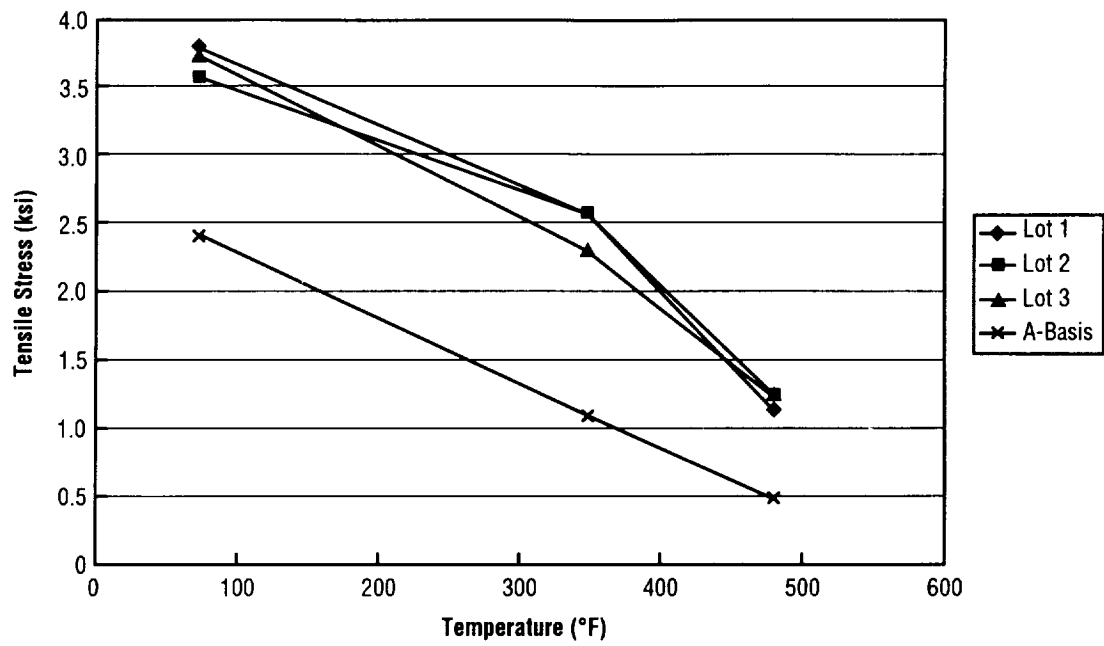


Figure 23. Foam edgewise tensile stress.

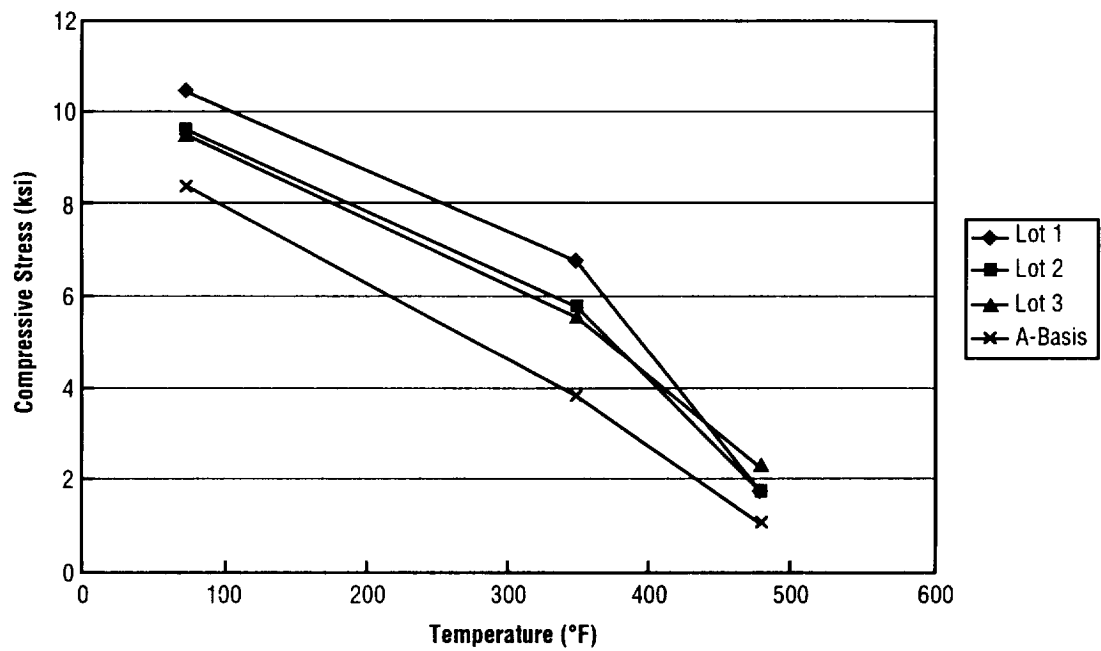


Figure 24. Foam compression.

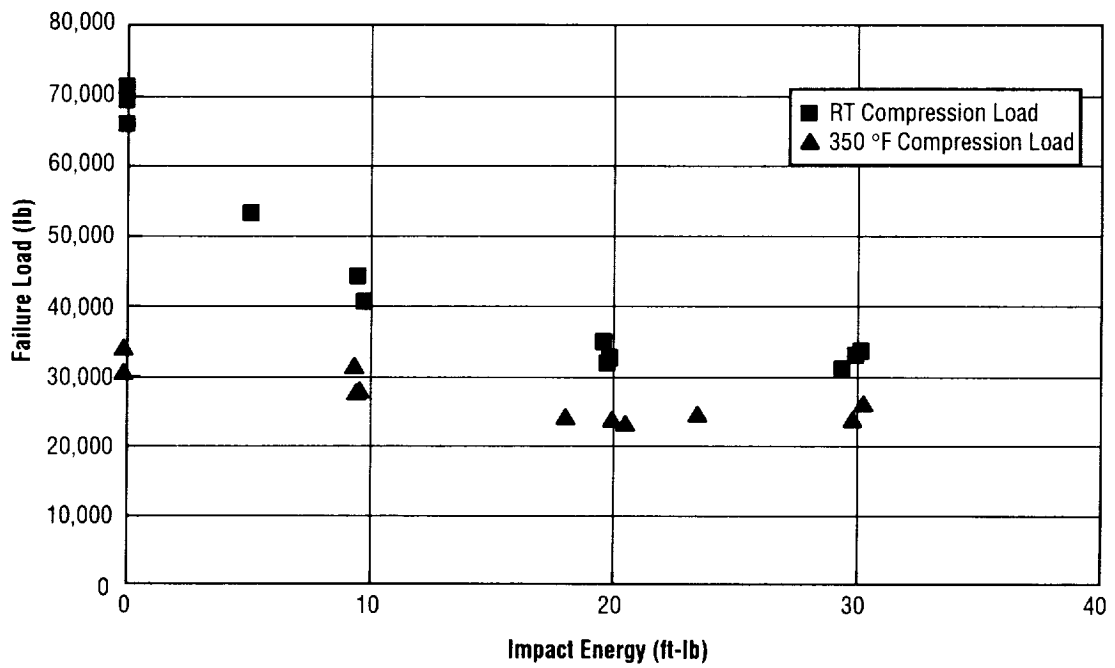


Figure 25. Boeing compression after impact strength at 75 and 350 °F.

APPENDIX B—A DETAILED SUMMARY OF THE DATA

Table 8. Test result data in detail.

Lot 1, Tensile Testing of AS4/3501-6 Lot 1, Warp, 75 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	E ₁₁ (ext) (Msi)	ν ₁₂ (gauge)
CNC-001-103	L1	1.001	0.085	0.92*	107.7	10.3	0.06
CNC-001-103	L5	0.999	0.086	0.94*	111.6	9.6	0.06
CNC-001-103	L8	0.998	0.085		110.9	9.6	0.07
Panel Average			0.085	0.93*	110.1	9.8	0.06

* weight gain of witness sample

CNC-001-101	L1	0.995	0.087		103.4	9.8	0.06
CNC-001-101	L7	0.998	0.085		111.5	9.6	0.04
CNC-001-101	L9	1.001	0.087		111.0	10.0	0.04
Panel Average			0.086		108.6	9.8	0.05

CNC-001-104	L5	1.004	0.085		114.9	9.9	0.05
CNC-001-104	L10	1.003	0.086		113.9	9.9	0.06
CNC-001-104	L13	0.999	0.086		114.1	9.8	0.07
Panel Average			0.085		114.3	9.9	0.06

CNC-001-102	L13	1.001	0.087		110.2	10.3	0.07
CNC-001-102	L2	1.005	0.087		116.0	10.9	0.05
CNC-001-102	L9	1.001	0.088		109.5	10.1	0.06
Panel Average			0.087		111.9	10.4	0.06
Lot Average					111.2	10.0	0.06
Std. Dev.					3.4	0.38	0.01

Lot 1, Tensile Testing of AS4/3501-6, Warp, 240 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	E ₁₁ (ext) (Msi)
101B	3	0.998	0.087	0.42	104.9	9.6
101C	3	1.001	0.088	0.43	101.9	10.1
101C	4	1.000	0.088	0.44	109.6	9.3
101B	7	1.001	0.087	0.43	100.7	9.4
101C	10	1.000	0.088	0.43	113.0	9.4
101B	14	1.001	0.087	0.43	106.2	9.4
Average				0.43	106.0	9.6
Std. Dev.				0.00	4.7	0.3

Lot 1, Tensile Testing of AS4/3501-6, Warp, 350 °F*

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Strain (in./in.)	Modulus (Msi)
CNC-001-101A	TL11	1.001	0.087	0.55	95.0	0.01190	8.2
CNC-001-101A	TL9	0.998	0.087	0.55	94.2	0.01119	8.5
CNC-001-102	TL11	0.998	0.088	0.54	93.4	0.01134	8.5
CNC-001-103	LT9	1.000	0.087	0.41	89.0	0.01190	7.7
CNC-001-104	TL11	0.997	0.087	0.55	92.1	0.01390	7.3
CNC-001-104	TL9	1.001	0.087	0.49	87.3	0.01256	7.8
Lot Average			0.087	0.52	91.8	0.01213	8.0
Std. Dev.			0.001	0.06	3.1	0.00099	0.5

Lot 1, Tensile Testing of AS4/3501-6, Warp, 550 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Strain (in./in.)	Modulus (Msi)
CNC-001-101A	TL7	1.001	0.086	0.62	65.7	0.01273	5.4
CNC-001-102	TL3	0.993	0.088	0.55	72.9	0.01243	6.3
CNC-001-102	TL5	0.994	0.086	0.53	76.1	0.01036	7.0
CNC-001-101	LT5	0.997	0.087	0.43	64.5	0.01048	4.6
CNC-001-103	TL7	0.998	0.086	0.45	72.2	0.01174	6.3
CNC-001-104	TL7	0.998	0.085	0.56	66.7	0.01132	5.5
Lot Average			0.086	0.52	69.7	0.01151	5.8
Std. Dev.			0.001	0.07	4.7	0.00098	0.8

Lot 1, Tensile Testing of AS4/3501-6, Warp, 350 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
101B	2	1.003	0.087	0.41	100.9	7.9
101B	6	1.001	0.087	0.44	97.3	7.2
101B	12	0.985	0.087	0.44	101.0	7.1
101B	1	0.999	0.084	0.41	107.3	7.4
101C	5	1.002	0.087	0.45	102.5	7.4
101C	6	1.000	0.087	0.46	100.9	6.8
101C	9	0.999	0.088	0.42	100.8	7.3
101C	1	1.002	0.088	0.44	93.4	7.7
Average				0.43	100.5	7.4
Std. Dev.				0.02	4.0	0.4

Lot 1, Tensile Testing of AS4/3501-6, Warp, 480 °F

Panel ID	Spec ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
101B-015		0.999	0.087	0.41	62.3	4.8
101B-010		0.999	0.087	0.43	65.4	4.3
101B-011		1.002	0.087	0.45	80.4	5.3
101B-004		1.001	0.087	0.41	77.6	5.6
101C-002		1.002	0.088	0.42	77.9	6.3
101C-007		1.001	0.089	0.41	79.3	5.5
101C-008		1.001	0.008	0.40	80.4	6.7
101C-011		1.004	0.086	0.44	73.7	5.4
Average				0.42	74.6	5.5
Std. Dev.				0.02	7.0	0.8

Lot 2, Tensile Testing of AS4/3501-6, Warp, 75 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Strain (in./in.)	Modulus (Msi)	ν_{12} (gauge)
CNC-001-108	L8	1.001	0.086	0.50	112.8	0.01183	9.3	0.04
CNC-001-108	L4	1.000	0.086	0.47	118.1	0.01208	9.6	0.11
CNC-001-108	L12	1.003	0.084	0.50	122.3	0.01207	10.3	0.05
Panel Average		1.001	0.085	0.49	117.7	0.01199	9.7	0.07

CNC-001-107	L7	1.000	0.085	0.50	117.7	0.01195	10.3	0.03
CNC-001-107	L3	0.997	0.086	0.50	114.7	0.01155	10.3	0.05
CNC-001-107	L11	1.000	0.086	0.50	111.6	0.01200	9.6	0.05
Panel Average		0.999	0.086	0.50	114.7	0.01183	10.0	0.04

CNC-001-106	L6	1.005	0.088	0.57	108.1	0.01172	9.4	
CNC-001-106	L2	1.004	0.086	0.63	117.3	0.01214	9.8	0.11
CNC-001-106	L10	1.004	0.087	0.58	117.3	0.01263	9.4	0.06
Panel Average		1.004	0.087	0.59	114.2	0.01216	9.5	0.09

CNC-001-105	L9	1.002	0.086	0.61	101.1	0.01031	9.7	0.06
CNC-001-105	L5	1.001	0.087	0.55	105.8	0.01112	9.6	0.03
CNC-001-105	L1	1.003	0.082	0.57	104.4	0.01166	10.7	0.11
Panel Average		1.002	0.085	0.58	103.7	0.01103	10.0	0.07

Lot Average				0.54	112.6	0.01175	9.8	0.06
Std. Dev.				0.05	6.5	0.00059	0.5	0.03

Lot 2, Tensile Testing of AS4/3501-6, Warp, 240 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (psi)	Modulus (psi)
CNC-001-105	L6	1.00	0.09		110.57	8.0
CNC-001-105	L2	1.00	0.08		109.74	8.8
CNC-001-105	L10	1.00	0.09		111.18	7.4
Average					110.50	8.1
Std. Dev.					0.73	0.7
CNC-001-106	L7	1.00	0.09		117.47	9.4
CNC-001-106	L3	1.00	0.09		113.31	9.0
CNC-001-106	L11	1.00	0.09		108.58	11.2
Average					113.12	9.9
Std. Dev.					4.45	1.2
CNC-001-107	L12	1.00	0.09		115.28	10.3
CNC-001-107	L4	1.00	0.09		119.00	10.1
CNC-001-107	L8	1.00	0.09		113.47	10.0
Average					115.91	10.1
Std. Dev.					2.82	0.2
CNC-001-108	L1	1.00	0.09		112.84	9.9
CNC-001-108	L5	1.00	0.09		111.80	10.8
CNC-001-108	L9	1.00	0.08		115.22	11.7
Average					113.28	10.8
Std. Dev.					1.75	0.9
Lot Average				0.48	113.20	9.7
Std. Dev.					3.12	1.3

Lot 2, Tensile Testing of AS4/3501-6, Warp, 350 °F*

Panel ID	Sample ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-105	L3	1.004	0.086	0.53	94.1	6.9
CNC-001-105	L7	1.007	0.087	0.47	89.2	8.9
CNC-001-105	L11	1.004	0.087	0.49	81.3	6.9
Average				0.50	88.2	7.6

partial shear
partial shear
shear

CNC-001-106	L4	1.003	0.086	0.49	94.3	
CNC-001-106	L8	1.000	0.086	0.52	99.4	
CNC-001-106	L12	1.000	0.086	0.50	98.2	
Average				0.51	97.3	

CNC-001-107	L1	1.003	0.081	0.45	110.4	
CNC-001-107	L5	1.005	0.087	0.46	108.0	
CNC-001-107	L9	0.999	0.087	0.46	108.0	
Average				0.46	108.8	

CNC-001-108	L2	1.001	0.086	0.43	93.9	7.2
CNC-001-108	L6	1.003	0.087	0.46	93.0	7.6
CNC-001-108	L10	1.001	0.087	0.46	101.5	7.3
Average				0.45	96.2	7.4

partial shear

Average				0.48	97.6	7.5
Std. Dev.				0.03	8.5	0.7
COV				6	8.7	9.7

Lot 2, Tensile Warp Retest, 350 °F*

Panel ID	Sample ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-105	L13	1.000	0.084	0.51	100.9	10.6
CNC-001-105	L14X	1.003	0.085	0.50	97.5	8.6
CNC-001-105	L15X	1.000	0.085	0.49	99.2	9.0
Average				0.50	99.2	9.4

CNC-001-106	L13	1.001	0.085	0.50	101.2	9.2
CNC-001-106	L14X	1.001	0.086	0.50	89.3	7.5
CNC-001-106	L15X	1.000	0.086	0.51	93.5	8.5
Average				0.50	94.6	8.4

CNC-001-107	L13	1.000	0.085	0.45	85.0	8.3
CNC-001-107	L14X	1.001	0.085	0.45	72.7	7.5
CNC-001-108	L13	1.000	0.086	0.45	95.4	8.6

Average				0.48	92.7	8.6
Std. Dev.				0.03	9.2	0.9
COV				6	10	11

Average of all
Std. Dev.

95.5
8.9

8.2
1.0

Lot 2, Tensile Testing of AS4/3501-6, Warp, 550 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (psi)	Modulus (psi)
CNC-001-105	L4	1.00	0.09		68.5	6.0
CNC-001-105	L8	1.00	0.09		72.8	5.8
CNC-001-105	L12	1.00	0.09		76.0	6.0
Average					72.5	5.9

CNC-001-106	L1	1.01	0.08		74.4	6.1
CNC-001-106	L5	1.00	0.09		66.4	6.3
CNC-001-106	L9	1.00	0.09		68.1	5.4
Average					69.6	5.9

CNC-001-107	L2	1.00	0.08		75.1	5.6
CNC-001-107	L6	1.00	0.09		71.1	5.5
CNC-001-107	L10	1.00	0.09		72.8	6.3
Average					73.0	5.8

CNC-001-108	L3	1.00	0.09		75.8	5.7
CNC-001-108	L7	1.00	0.09		72.1	5.8
CNC-001-108	L11	1.00	0.09		71.4	5.6
Average					73.1	5.7

Average					72.1	5.8
Std. Dev.					3.1	0.3
COV				0.53	4	5

Lot 3, Tensile Testing of AS4/3501-6, Warp, 75 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)	ν_{12} (gauge)
CNC-001-109	4	0.090	1.001	0.39	116.0	9.1	0.07
CNC-001-109	7	0.090	1.001	0.41	106.0	9.8	0.04
CNC-001-109	13	0.089	1.002	0.39	107.5	9.7	0.05
CNC-001-110	4	0.089	1.002	0.37	110.7	9.9	0.10
CNC-001-110	5	0.089	0.999	0.37	111.7	9.3	0.04
CNC-001-110	10	0.089	1.001	0.39	110.1		0.07
CNC-001-111	9	0.089	1.001	0.41	111.2	9.7	0.04
CNC-001-111	10	0.090	1.001	0.41	112.9	9.3	0.05
CNC-001-111	13	0.090	1.002	0.37	105.8	9.4	0.06
CNC-001-112	5	0.089	1.001	0.42	111.9	9.4	0.06
CNC-001-112	8	0.089	1.001	0.41	112.2	9.9	0.04
CNC-001-112	12	0.089	1.003	0.45	114.6	9.8	0.04

Lot Average				0.40	110.9	9.6	0.05
Std. Dev.				0.02	3.1	0.3	0.02
COV				6	3	3	31

Lot 3, Tensile Testing of AS4/3501-6, Warp, 240 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-109	2	1.001	0.089	0.41	108.7	5.5
CNC-001-109	9	1.002	0.090	0.44	108.9	5.8
CNC-001-109	14	1.005	0.090	0.40	108.3	5.3
CNC-001-110	2	1.001	0.087	0.38	113.8	8.6
CNC-001-110	6	1.000	0.089	0.39	109.8	7.5
CNC-001-110	11	0.995	0.089	0.40	108.5	7.8
CNC-001-111	2	1.000	0.088	0.40	103.5	5.8
CNC-001-111	11	0.998	0.089	0.40	111.0	5.7
CNC-001-111	14	1.003	0.089	0.37	107.9	5.7
CNC-001-112	14	1.000	0.089	0.43	115.0	8.2
CNC-001-112	4	1.000	0.089	0.43	114.2	8.8
CNC-001-112	7	1.002	0.088	0.44	112.9	8.4
Lot Average				0.41	110.2	6.9
Std. Dev.				0.02	3.3	1.4
COV				5	3	20

Lot 3, Tensile Testing of AS4/3501-6, Warp, 350 °F*

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-109	1	1.002	0.089	0.45	57.5	5.7
CNC-001-109	5	1.001	0.090	0.43	82.4	5.5
CNC-001-109	6	1.000	0.090	0.44	94.1	5.7
CNC-001-110	7	1.001	0.089	0.41	78.2	3.9
CNC-001-110	9	1.002	0.089	0.41	95.5	4.7
CNC-001-110	12	1.001	0.090	0.39	76.3	5.1
CNC-001-111	6	1.003	0.087	0.41	109.9	6.0
CNC-001-111	1	1.003	0.087	0.40	107.1	6.4
CNC-001-111	8	0.999	0.090	0.42	77.1	4.8
CNC-001-112	1	1.002	0.086	0.44	102.2	7.0
CNC-001-112	2	1.003	0.087	0.44	114.9	7.9
CNC-001-112	9	0.999	0.089	0.44	112.6	6.1
Lot Average				0.42	92.3	5.7
Std. Dev.				0.02	18.0	1.1
COV				4	19	19

Lot 3, Tensile Testing of AS4/3501-6, Warp, 550 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-109	3	1.003	0.089	0.38	60.2	3.3
CNC-001-109	10	1.001	0.089	0.42	77.7	4.1
CNC-001-109	15	1.003	0.089	0.42	83.7	3.8
CNC-001-110	3	0.998	0.088	0.37	77.0	4.6
CNC-001-110	8	1.000	0.088	0.40	80.9	3.8
CNC-001-110	14	1.003	0.088	0.37	86.6	3.6
CNC-001-111	3	1.001	0.088	0.39	83.0	3.7
CNC-001-111	5	1.001	0.088	0.40	84.8	3.9
CNC-001-111	12	1.001	0.089	0.39	82.3	3.7
CNC-001-112	3	1.001	0.088	0.38	82.3	3.5
CNC-001-112	10	1.001	0.089	0.42	81.7	4.4
CNC-001-112	13	1.003	0.088	0.43	82.0	3.8
Lot Average				0.40	80.2	3.9
Std. Dev.				0.02	6.8	0.4
COV				5	9	9

Lot 1, Tensile Testing of AS4/3501-6, Fill, 75 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	E ₁₁ (ext) (Msi)	ν ₁₂ (gauge)
CNC-001-102	T4	0.998	0.086		104.5	9.8	0.07
CNC-001-102	T10	1.003	0.087		99.1	9.1	0.06
CNC-001-102	T11	1.000	0.087		105.7	9.3	0.05
CNC-001-103	T2	1.002	0.087		103.9	9.6	0.07
CNC-001-103	T5	1.002	0.087		112.2	10.2	0.06
CNC-001-103	T6	1.002	0.088		111.6	10.0	0.08
Panel Average			0.087		109.2	9.9	0.07
Lot Average					106.2	9.7	0.07
Std. Dev.					5.0	0.40	0.01

Lot 1, Tensile Testing of AS4/3501-6, Fill, 240 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
101C	1	1.001	0.086	0.43	103.9	8.9
101B	3	1.002	0.086	0.42	107.8	10.2
101C	6	1.001	0.087	0.43	105.1	9.0
101B	7	1.000	0.087	0.43	108.7	9.4
101B	8	1.000	0.087	0.42	108.9	10.0
101B	14	1.001	0.086	0.43	107.4	9.5
101B	15	1.002	0.087	0.46	99.4	10.0
101B	16	1.001	0.087	0.42	102.5	10.3
Average				0.43	105.5	9.7
Std. Dev.				0.01	3.4	0.5

Lot 1, Tensile Testing of AS4/3501-6, Lot 1, Fill, 350 °F*

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Strain (in./in.)	Modulus (Msi)
CNC-001-101A	TT1	0.999	0.083	0.60	103.9	0.01169	9.1
CNC-001-101A	TT8	0.999	0.087	0.56	98.4	0.01106	9.2
CNC-001-103	TT9	1.001	0.086	0.43	102.2	0.01063	9.9
CNC-001-103	TT8	1.003	0.088	0.40	101.8	0.01223	8.8
CNC-001-102	TT5	0.997	0.085	0.45	87.5	0.01117	8.2
CNC-001-102	TT13	1.003	0.086	0.45	91.8	0.01121	8.3
CNC-001-102	TT9	1.001	0.087	0.48	90.3	0.01082	8.3
CNC-001-104	TT2	0.997	0.085	0.48	92.1	0.01075	8.6
CNC-001-104	TT3	0.996	0.085	0.50	101.1	0.01237	8.5
CNC-001-104	TT9	0.998	0.086	0.47	100.1	0.01136	9.1
CNC-001-104	TT8	1.000	0.087	0.50	89.6	0.01050	8.8
Lot Average			0.086	0.48	96.3	0.01125	8.8
Std. Dev.			0.001	0.06	6.0	0.00062	0.5

Lot 1, Tensile Testing of AS4/3501-6, Fill, 550 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Strain (in./in.)	Modulus (Msi)
CNC-001-101A	TT11	1.002	0.087	0.56	56.2	0.01684	3.5
CNC-001-101A	TT7	1.000	0.085	0.59		0.01540	7.5
CNC-001-101A	TT3	1.002	0.087	0.67	55.0	0.01040	6.0
CNC-001-101A	TT6	1.000	0.088	0.72	53.9	0.00944	6.9
CNC-001-101	TT8	1.000	0.087	0.41	67.0	0.01028	6.3
CNC-001-102	TT9	1.002	0.089	0.47	64.9	0.01684	4.8
CNC-001-102	TT1	1.002	0.088	0.52	67.3	0.01211	5.7
CNC-001-103	TT7	1.002	0.088	0.45	68.5	0.01223	6.4
CNC-001-103	TT1	1.000	0.084	0.43	71.4	0.01684	5.2
CNC-001-103	TT3	1.002	0.087	0.44	72.4	0.01238	6.1
CNC-001-104	TT7	1.000	0.087	0.53	66.6	0.01879	4.0
CNC-001-104	TT1	1.000	0.084	0.45	65.3	0.00961	6.5
Lot Average			0.087	0.52	64.4	0.01343	5.7
Std. Dev.			0.002	0.10	6.5	0.00332	1.2

Lot 1, Tensile Testing of AS4/3501-6, Fill, 350 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
101C	4	1.001	0.085	0.40	77.4	7.7
101C	2	1.001	0.086	0.39	81.5	6.4
101C	3	1.000	0.086	0.40	80.7	5.8
101C	7	1.000	0.086	0.44	78.2	7.8
101B	10	1.000	0.086	0.40	91.4	8.3
101B	12	1.000	0.085	0.39	81.5	
101B	5	1.000	0.086	0.40	90.8	6.2
101B	1	1.001	0.084	0.37	93.7	8.2
Average				0.40	84.4	7.2
Std. Dev.				0.02	6.5	1.0

Lot 1, Tensile Testing of AS4/3501-6, Fill, 480 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
101B	11	1.000	0.087	0.39	69.0	8.2
101B	4	1.000	0.087	0.39	82.4	7.7
101B	6	1.001	0.087	0.40	79.0	6.4
101B	9	1.002	0.088	0.42	77.6	6.1
101B	2	1.000	0.086	0.41	78.3	6.2
101B	13	1.001	0.087	0.39	62.2	7.5
101C	5	1.000	0.088	0.40	63.0	5.5
101C	8	1.001	0.087	0.45	62.2	5.4
Average				0.41	71.7	6.6
Std. Dev.				0.02	8.5	1.0

Lot 2, Tensile Testing of AS4/3501-6, Fill, 75 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Strain (in./in.)	Modulus (Msi)	ν_{12} (gauge)
CNC-001-108	T7	1.004	0.087	0.49	100.9	0.01195	9.2	0.06
CNC-001-108	T3	1.003	0.085	0.49	99.9	0.01164	9.6	
CNC-001-108	T11	1.005	0.087	0.49	120.2	0.01173	10.3	
CNC-001-107	T8	1.004	0.087	0.53	115.3	0.01153	10.0	0.07
CNC-001-107	T4	1.004	0.085	0.51	115.1	0.01128	10.1	
CNC-001-107	T12	1.000	0.086	0.56	98.2	0.01080	9.7	0.07
CNC-001-106	T9	1.002	0.085	0.58	81.9	0.00946	9.0	
CNC-001-106	T5	1.003	0.086	0.51	88.5	0.01007	8.7	0.04
CNC-001-106	T1	1.001	0.083	0.51	90.2	0.00901	10.6	0.03
CNC-001-105	T6	1.000	0.086	0.52	110.3	0.01113	10.2	0.05
CNC-001-105	T2	1.004	0.085	0.51	111.7	0.01120	9.8	0.05
CNC-001-105	T10	1.004	0.087	0.50	102.7	0.01098	9.3	0.09
Lot Average				0.52	102.9	0.01090	9.7	0.06
Std. Dev.				0.03	12.0	0.00092	0.6	0.02
COV				6	12	8	6	30

Lot 2, Tensile Testing of AS4/3501-6, Fill, 240 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-105	T11	1.003	0.087		91.3	5.0
CNC-001-105	T3	1.000	0.087		106.3	8.2
CNC-001-105	T7	1.000	0.087		104.3	7.4
Average					100.6	6.9
CNC-001-106	T10	1.004	0.087		94.2	6.0
CNC-001-106	T2	1.003	0.087		77.2	5.2
CNC-001-106	T6	1.001	0.087		74.9	5.9
Average					82.1	5.7
CNC-001-107	T1	1.002	0.085		108.8	7.9
CNC-001-107	T5	1.004	0.087		103.4	7.4
CNC-001-107	T9	1.002	0.086		115.2	7.3
Average					109.1	7.5
CNC-001-108	T12	1.003	0.087		110.8	9.2
CNC-001-108	T4	1.004	0.088		83.0	5.1
CNC-001-108	T8	1.003	0.087		90.0	5.1
Average					94.6	6.5
Lot Average				0.50%	96.6	6.6
Std. Dev.					13.5	1.4
COV					14	22

Lot 2, Tensile Testing of AS4/3501-6, Fill, 350 °F*

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)	
CNC-001-105	T4	1.001	0.086	0.45	100.8		tens/interlaminar
CNC-001-105	T8	1.001	0.086	0.45	91.5	7.9	tensile
CNC-001-105	T12	1.003	0.087	0.45	82.6		shear
Panel Average		1.002	0.086	0.45	91.6	7.9	
CNC-001-106	T3	1.004	0.087	0.49	63.0	5.6	shear
CNC-001-106	T7	1.002	0.087	0.46	62.4	6.3	shear
CNC-001-106	T11	1.003	0.087	0.46	79.8	5.5	tensile
Panel Average		1.003	0.087	0.47	68.4	5.8	
CNC-001-107	T2	1.003	0.086	0.46	109.2		tensile
CNC-001-107	T6	0.998	0.086	0.44			overheated
CNC-001-107	T10	1.000	0.086	0.46	79.2	9.4	tensile
Panel Average		1.000	0.086	0.45	94.2	9.4	
CNC-001-108	T1	1.002	0.078	0.43	75.4	8.4	shear
CNC-001-108	T5	1.001	0.087	0.45	71.3	3.9	shear
CNC-001-108	T9	1.004	0.087	0.49	77.9	5.7	tens/interlaminar
Panel Average		1.002	0.084	0.46	74.8	6.0	
Lot Average				0.46	81.2	6.6	
Std. Dev.				0.02	14.5	1.8	
COV				4	18	27	

Lot 2, Tensile Testing of AS4/3501-6, Fill, 550 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-105	T5	1.000	0.086	0.46	61.3	5.0
CNC-001-105	T9	0.999	0.085	0.45	65.0	5.0
CNC-001-105	T13	1.002	0.085	0.48	49.1	4.0
Average				0.46	58.4	4.7

CNC-001-106	T4	1.000	0.086	0.47	35.0	2.8
CNC-001-106	T8	0.999	0.085	0.48	36.4	2.7
CNC-001-106	T12	1.000	0.086	0.50	52.3	3.6
Average				0.49	41.2	3.0

CNC-001-107	T3	1.000	0.084	0.46	69.2	6.0
CNC-001-107	T7	0.998	0.084	0.45	63.7	4.9
CNC-001-107	T11	0.998	0.085	0.47	38.6	3.4
Average				0.46	57.2	4.8

CNC-001-108	T2	1.001	0.085	0.46	38.7	3.5
CNC-001-108	T6	1.001	0.085	0.46	44.7	4.1
CNC-001-108	T10	1.000	0.086	0.46	56.3	4.1
Average				0.46	46.6	3.9
Lot Average				0.47	50.9	4.1
Std. Dev.				0.02	12.2	1.0
COV				3	24	24

Lot 3, Tensile Testing of AS4/3501-6, Fill, 75 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)	ν_{12} (gauge)
CNC-001-109	3	0.089	1.000	0.41	90.0	10.1	
CNC-001-109	6	0.088	0.998	0.39	93.1	9.8	0.07
CNC-001-109	10	0.089	1.001	0.40	94.6	9.9	0.09
CNC-001-110	5	0.087	1.000	0.37	101.2	9.3	0.05
CNC-001-110	13	0.087	1.002	0.46	111.5	9.8	0.07
CNC-001-110	14	0.087	1.000	0.44	112.4	9.5	0.07
CNC-001-111	2	0.089	1.002	0.39	109.1	9.4	0.08
CNC-001-111	3	0.088	1.002	0.41	111.5	10.0	0.06
CNC-001-111	4	0.089	1.001	0.41	112.6	9.2	0.12
CNC-001-112	2	0.088	1.003	0.38	113.5	10.0	0.07
CNC-001-112	7	0.088	1.003	0.37	112.6	9.4	0.07
CNC-001-112	9	0.090	1.000	0.39	104.4	9.1	0.07
Lot Average				0.40	105.5	9.6	0.07
Std. Dev.				0.03	8.7	0.3	0.02
COV				7	8	4	24

Lot 3, Tensile Testing of AS4/3501-6, Fill, 240 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-109	1	0.996	0.088	0.41	91.7	8.9
CNC-001-109	2	1.000	0.086	0.38	95.7	7.8
CNC-001-109	9	1.000	0.086	0.42	93.6	8.7
CNC-001-110	1	0.999	0.084	0.35	96.6	
CNC-001-110	11	1.002	0.086	0.51	110.9	9.8
CNC-001-110	12	1.000	0.086	0.47	106.1	10.5
CNC-001-111	6	1.001	0.086	0.42	118.0	9.3
CNC-001-111	7	1.000	0.087	0.40	118.7	5.5
CNC-001-111	8	1.000	0.086	0.39	115.9	9.3
CNC-001-112	4	1.000	0.086	0.39	109.6	5.7
CNC-001-112	5	1.000	0.085	0.39	116.8	6.6
CNC-001-112	13	1.003	0.084	0.48	113.8	5.1
Lot Average				0.42	107.3	7.9
Std. Dev.				0.05	10.2	1.9
COV				11	10	24

Lot 3, Tensile Testing of AS4/3501-6, Fill, 350 °F*

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-109	7	1.001	0.089	0.42	51.4	2.5
CNC-001-109	8	1.002	0.090	0.43	64.3	4.0
CNC-001-109	11	1.001	0.090	0.53	54.7	4.0
CNC-001-110	2	1.002	0.089	0.38	60.6	3.0
CNC-001-110	3	1.002	0.089	0.38	49.1	2.9
CNC-001-110	9	1.002	0.089	0.39	61.3	3.6
CNC-001-111	9	1.001	0.089	0.43	95.9	7.0
CNC-001-111	11	1.001	0.089	0.51	63.5	3.1
CNC-001-111	13	1.000	0.090	0.50	54.5	1.7
CNC-001-112	3	1.002	0.088	0.40	64.3	4.1
CNC-001-112	10	1.003	0.088	0.41	67.7	5.4
CNC-001-112	11	1.003	0.088	0.54	86.9	5.8
Lot Average				0.44	64.5	3.9
Std. Dev.				0.06	13.9	1.5
COV				14	22	39

Lot 3, Tensile Testing of AS4/3501-6, Fill, 550 °F

Panel ID	Spec. ID	Width (in.)	Thickness (in.)	Wt. Gain (%)	Stress (ksi)	Modulus (Msi)
CNC-001-109	7	0.999	0.090	0.38	49.8	
CNC-001-109	8	1.001	0.090	0.48	39.4	
CNC-001-109	11	1.002	0.090	0.47	37.3	
CNC-001-110	2	1.001	0.089	0.33	50.8	1.9
CNC-001-110	3	1.003	0.089	0.33	46.7	1.5
CNC-001-110	9	1.000	0.089	0.50	45.3	1.0
CNC-001-111	9	1.000	0.083	0.36	88.8	4.4
CNC-001-111	11	1.001	0.090	0.47	53.8	1.6
CNC-001-111	13	1.001	0.086	0.48	52.1	2.3
CNC-001-112	3	1.001	0.087	0.36	74.6	4.1
CNC-001-112	10	1.004	0.088	0.47	74.7	2.7
CNC-001-112	11	1.001	0.088	0.47	74.1	3.2
Lot Average				0.43	57.3	2.5
Std. Dev.				0.07	16.5	1.2
COV				15	29	47

Lot 1, Compression Testing of AS4/3501-6, Warp, 75 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
CL-3	102	0.85	0.504	0.088	78.0	0.034	8.7
CL-9	101	0.88	0.503	0.087	82.5	0.027	8.5
CL-11	101A	0.90	0.504	0.084	66.8	0.017	8.5
CL-1	101	0.89	0.503	0.086	76.7	0.042	8.3
CL-5	103	0.93	0.503	0.087	72.4	0.025	8.0
CL-9	104	0.91	0.504	0.088	89.5	0.015	8.1
Average		0.89	0.503	0.086	77.6	0.027	8.4
Std. Dev.		0.03	0.001	0.002	7.9	0.010	0.3

Lot 1, Compression Testing of AS4/3501-6, Fill, 75 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
CT-1	101	0.89	0.500	0.086	85.7	0.028	7.5
CT-5	103	0.92	0.502	0.087	77.0	0.010	8.9
CT-3	102	0.87	0.504	0.088	75.7	0.036	7.2
CT-9	101	0.88	0.501	0.085	77.3	0.016	9.4
CT-9	104	0.91	0.504	0.086	85.0	0.010	9.5
CT-11	101A	0.93	0.504	0.085	77.4	0.120	9.6
Average		0.90	0.502	0.086	79.7	0.037	8.7
Std. Dev.		0.02	0.002	0.001	4.4	0.042	1.1

Lot 1, Compression Testing of AS4/3501-6, Warp, 240 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L2	101C	0.87	0.501	0.089	32.0	0.00547	7.5
L4	101C	0.88	0.501	0.088	38.0	0.01121	7.0
L6	101C	0.90	0.501	0.088	46.2	0.01591	8.1
L8	101C	0.89	0.501	0.089	43.3	0.01044	8.0
L10	101C	0.89	0.502	0.089	43.2	0.01858	8.4
L13	101B	0.81	0.504	0.082	39.6	0.00840	8.6
Average		0.87	0.502	0.087	40.4	0.01167	7.9
Std. Dev.		0.03	0.001	0.003	5.0	0.00483	0.6

Lot 1, Compression Testing of AS4/3501-6, Fill, 240 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T1	101C	0.94	0.502	0.088	43.5	0.01291	7.1
T3	101C	0.90	0.501	0.088	32.6	0.00530	6.4
T5	101C	0.90	0.502	0.088	38.1	0.00617	8.1
T7	101C	0.93	0.502	0.089	40.5	0.01674	8.0
T9	101C	0.95	0.502	0.089	38.4	0.00698	8.1
T11	101C	0.88	0.501	0.087	48.3	0.01509	7.9
Average		0.87	0.501	0.088	40.2	0.01053	7.6
Std. Dev.		0.03	0.000	0.001	5.3	0.00498	0.7

Lot 1, Compression Testing of AS4/3501-6, Warp, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)
LCL-002	101B	0.97	0.501	0.084	26.8	0.0044
LCL-003	101B	0.99	0.501	0.084	26.0	0.0015
LCL-007	101B	0.99	0.503	0.085	27.1	0.0032
LCL-008	101B	0.99	0.502	0.085	26.1	0.0028
LCL-009	101B	1.01	0.502	0.085	19.6	0.0011
Average		0.99	0.502	0.085	25.1	0.0026
Std. Dev.		0.01	0.001	0.001	3.1	0.0013

Lot 1, Compression Testing of AS4/3501-6, Fill, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thicknes (in.)	Stress (ksi)	Strain (%)
CT-3	101	0.87	0.502	0.086	24.0	0.0034
CT-7	101A	0.89	0.503	0.084	27.8	0.0040
CT-11	104	0.88	0.503	0.087	22.3	0.0029
CT-13	101A	0.86	0.503	0.083	22.1	0.0028
Average		0.88	0.503	0.085	24.1	0.0033
Std. Dev.		0.01	0.000	0.002	2.6	0.0005

Lot 1, Compression Testing of AS4/3501-6, Warp retest, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
LCL-002	101B	0.97	0.501	0.084	26.8	0.0044	7.6
LCL-003	101B	0.99	0.501	0.084	26.0	0.0015	0.0
LCL-007	101B	0.99	0.503	0.085	27.1	0.0032	6.5
LCL-008	101B	0.99	0.502	0.085	26.1	0.0028	6.2
LCL-009	101B	1.01	0.502	0.085	19.6	0.0011	0.0
L3	101C	0.84	0.501	0.088	24.2	0.0110	5.8
L10	101C	0.81	0.502	0.088	24.1	0.0049	4.9
L10	103	0.79	0.502	0.088	18.8	0.0083	5.8
Average		0.92	0.502	0.086	24.1	0.0047	6.1
Std. Dev.		0.09	0.001	0.002	3.2	0.0034	0.9

Lot 1, Compression Testing of AS4/3501-6, Fill retest, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T13	101B	0.75	0.503	0.082	24.2	0.0165	2.4
T3	101C	0.80	0.502	0.087	23.5	0.0088	4.4
T7	101C	0.79	0.502	0.087	22.1	0.0055	4.2
T8	101C	0.79	0.501	0.088	26.2	0.0081	5.2
T10	101C	0.77	0.502	0.088	25.6	0.0038	5.3
T6	103	0.76	0.502	0.087	21.6	0.0127	3.9
T11	103	0.78	0.502	0.087	24.0	0.0081	5.2
T16	103	0.79	0.502	0.087	25.8	0.0092	2.8
T22	103	0.78	0.502	0.087	21.7	0.0068	4.2
T24	103	0.79	0.501	0.087	23.8	0.0061	3.9
Average		0.78	0.502	0.086	23.9	0.0091	4.2
Std. Dev.		0.02	0.000	0.002	1.7	0.0040	1.0

Lot 1, Compression Testing of AS4/3501-6, Warp, 600 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L1	101C	0.94	0.504	0.088	4.4	0.0033	1.9
L3	101C	0.90	0.503	0.084	3.0	0.0059	1.4
L5	101C	0.90	0.502	0.086	4.1	0.0022	2.0
L7	101C	0.93	0.503	0.084	3.1	0.0048	2.0
L9	101C	0.95	0.502	0.085	3.9	0.0043	3.1
L11	101C	0.88	0.503	0.085	3.9	0.0045	3.2
Average		0.92	0.503	0.085	3.7	0.0042	2.3
Std. Dev.		0.03	0.001	0.002	0.5	0.0012	0.7

Lot 1, Compression Testing of AS4/3501-6, Fill, 600 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T2	101C	0.87	0.502	0.086	4.6	0.0059	2.7
T4	101C	0.87	0.502	0.086	4.1	0.0063	0.8
T6	101C	0.87	0.503	0.087	4.3	0.0062	0.7
T8	101C	0.90	0.500	0.087	4.3	0.0067	1.3
T10	101C	0.89	0.503	0.083	4.7	0.0054	1.2
T12	101B	0.87	0.502	0.084	4.5	0.0087	1.3
Average		0.88	0.502	0.085	4.4	0.0065	1.3
Std. Dev.		0.01	0.001	0.002	0.2	0.0011	0.7

Lot 1, Compression Testing of AS4/3501-6, Warp, 350 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L1	101C	0.90	0.501	0.088	12.8	0.0012	7.2
L5	101C	0.89	0.502	0.088	17.0	0.0064	6.6
L7	101C	0.93	0.502	0.088	13.1	0.0077	8.8
L9	101C	0.95	0.502	0.089	13.1	0.0044	7.8
L2	103	0.87	0.502	0.087	11.6	0.0028	4.1
L4	103	0.87	0.502	0.086	11.0	0.0040	5.0
L6	103	0.88	0.502	0.087	11.6	0.0098	6.8
L8	103	0.88	0.502	0.087	10.0	0.0023	5.4
Average		0.90	0.502	0.087	12.5	0.0048	6.5
Std. Dev.		0.03	0.000	0.001	2.1	0.0029	1.6

Lot 1, Compression Testing of AS4/3501-6, Fill, 350 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T7	101B	0.85	0.504	0.087	10.1	0.0031	5.5
T9	101B	0.87	0.503	0.086	12.5	0.0017	6.6
T2	101C	0.93	0.502	0.087	13.5	0.0053	8.0
T6	101C	0.94	0.502	0.088	13.1	0.0022	8.1
T1	103	0.87	0.503	0.085	11.6	0.0022	4.0
T15	103	0.85	0.502	0.087	10.9	0.0030	5.3
T27	103	0.84	0.502	0.087	10.5	0.0034	4.5
T31	103	0.74	0.501	0.082	10.7	0.0015	6.8
Average		0.86	0.502	0.086	11.6	0.0028	6.1
Std. Dev.		0.06	0.001	0.002	1.3	0.0012	1.5

Lot 1, Compression Testing of AS4/3501-6, Warp, 480°F Longitudinal

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L2	101C	0.85	0.502	0.088	5.7	0.0039	3.6
L4	101C	0.85	0.502	0.088	5.5	0.0013	3.7
L6	101C	0.87	0.502	0.088	5.1	0.0010	2.4
L8	101C	0.85	0.502	0.088	5.5	0.0030	3.5
L12	103	0.82	0.502	0.087	4.8	0.0031	2.4
L3	103	0.81	0.502	0.087	4.7	0.0028	3.1
L56	103	0.80	0.502	0.086	5.1	0.0011	3.0
L7	103	0.81	0.502	0.087	5.0	0.0013	2.5
Average		0.83	0.502	0.087	5.2	0.0022	3.0
Std. Dev.		0.02	0.000	0.001	0.3	0.0011	0.5

Lot 1, Compression Testing of AS4/3501-6, Fill, 480 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T8	101B	0.81	0.503	0.086	5.8	0.0005	2.5
T10	101B	0.82	0.503	0.086	6.2	0.0020	2.0
T1	101C	0.87	0.503	0.087	5.8	0.0047	2.8
T5	101C	0.89	0.502	0.087	6.1	0.0018	3.1
T4	103	0.89	0.502	0.087	5.7	0.0022	3.5
T10	103	0.82	0.503	0.087	4.9	0.0037	3.4
T13	103	0.79	0.502	0.087	5.8	0.0031	2.9
T29	103	0.78	0.503	0.088	5.4	0.0028	2.6
Average		0.83	0.502	0.087	5.7	0.0026	2.9
Std. Dev.		0.04	0.001	0.001	0.4	0.0013	0.5

Lot 2, Compression Testing of AS4/3501-6, Warp, 75 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
CL-006	105	0.89	0.499	0.084	85.2	0.0144**	16.6
CL-010	105	0.91	0.498	0.085	57.2	0.0144**	29.7
CL-005	106	0.94	0.500	0.083	88.8	0.0250	3.9
CL-006	106	0.94	0.500	0.083	86.3	0.0090	8.2
CL-011	106	0.93	0.500	0.083	98.1	0.0110	9.3
CL2	107	0.86	0.501	0.082	93.1	0.0110	9.1
CL6	107	0.87	0.501	0.084	88.7	0.0110	9.1
CL13	107	0.83	0.501	0.080	88.9	0.0090	9.3
CL3	108	0.87	0.500	0.082	92.4	0.0100	9.4
CL5	108	0.87	0.500	0.083	93.5	0.0120	9.3
CL13	108	0.81	0.501	0.077	84.0	0.0100	10.2
*CL-009	106	0.91	0.500	0.085	88.8	0.0110	8.0
*L3	107	0.84	0.500	0.084	85.7	0.0120	8.3
*L8	108	0.81	0.501	0.080	68.8	0.0080	8.4
Average		0.88	0.500	0.082	85.7	0.0116	10.6
Std. Dev.		0.05	0.001	0.002	10.6	0.004	6.1

* These samples tested unsupported with finger tight torque.

** Using the averaging extensometer

Lot 2, Compression Testing of AS4/3501-6, Warp, 240 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
LCL-002	105	0.93	0.498	0.084	46.5	0.0121	8.4
LCL-004	105	0.92	0.499	0.083	32.0	0.0124	8.6
LCL0-13	105	0.93	0.499	0.084	41.8	0.0134	7.8
LCL-001	106	0.95	0.500	0.084	37.1	0.0102	7.4
LCL-004	106	0.96	0.500	0.082	39.0	0.0083	6.8
LCL-008	106	1.17	0.501	0.084	36.4	0.0148	6.6
L5	107	0.89	0.500	0.084	37.6	0.0036	6.1
L8	107	0.88	0.500	0.083	41.2	0.0078	7.4
L12	107	0.87	0.501	0.082	47.6	0.0092	8.1
L4	108	0.88	0.499	0.083	45.6	***	
L9	108	0.90	0.500	0.084	44.0	0.0084	8.7
L11	108	0.91	0.500	0.083	45.2	0.0122	8.4
Average		0.93	0.500	0.083	41.2	0.0102	7.7
Std. Dev.		0.08	0.001	0.001	4.8	0.0032	0.9

*** Extensometer pins left (in.)

Lot 2, Compression Testing of AS4/3501-6, Warp, 600 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
CL-3	105	0.83	0.498	0.083	3.7	0.0206	1.1
CL-5	105	0.81	0.499	0.083	3.8	0.0081	2.5
CL-7	105	0.83	0.499	0.083	3.9	0.0111	1.4
CL-3	106	0.85	0.500	0.083	4.0	0.0093	1.6
CL-10	106	0.85	0.500	0.085	3.7	0.1086	0.5
CL-13	106	0.86	0.500	0.085	3.5	***	
L1	107	0.79	0.500	0.083	3.9	0.0279	0.6
L10	107	0.79	0.501	0.085	3.4	0.0164	0.4
L14	107	0.78	0.501	0.084	4.4	0.0063	1.8
L1	108	0.80	0.501	0.083	3.6	0.0387	0.6
L6	108	0.79	0.500	0.084	3.4	0.0549	0.5
L10	108	0.82	0.500	0.084	4.0	0.0411	1.9
Average		0.82	0.500	0.084	3.8	0.0312	1.2
Std. Dev.		0.03	0.001	0.001	0.3	0.0301	0.7

Lot 2, Compression Testing of AS4/3501-6, Warp, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L1	105	0.83	0.501	0.086	16.0	0.01433	3.5
L8	105	0.84	0.502	0.085	16.6	0.02725	0.6
L11	105	0.84	0.502	0.085	15.7	0.01726	0.9
L2	106	0.86	0.503	0.085	14.7	0.01076	3.9
L7	106	0.87	0.502	0.085	12.0	0.00381	5.6
L12	106	0.83	0.502	0.084	15.6	0.00729	4.7
L4	107	0.79	0.503	0.085	20.9	0.01012	3.6
L7	107	0.77	0.503	0.085	21.4	0.00907	5.4
L9	107	0.78	0.503	0.085	21.5	0.01234	5.4
L2	108	0.79	0.502	0.083	21.1	0.00892	2.2
L7	108	0.79	0.502	0.084	26.4	0.00757	6.9
L12	108	0.80	0.503	0.084	18.7	0.00976	3.5
Average		0.82	0.502	0.084	18.4	0.01154	3.8
Std. Dev.		0.03	0.001	0.001	4.0	0.00603	1.9

Lot 2, Compression Testing of AS4/3501-6, Fill, 75 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
LCT-005	105	0.89	0.500	0.085	83.0	0.0100	8.7
LCT-006	105	0.89	0.499	0.084	83.6	0.0100	9.1
LCT-009	105	0.91	0.499	0.085	79.3	0.0100	8.5
LCT-002	106	0.93	0.500	0.082	82.8	0.0090	9.3
LCT-003	106	0.94	0.500	0.082	86.3	0.0110	8.6
LCT-004	106	0.95	0.500	0.082	79.1	0.0100	9.1
T2	107	0.88	0.501	0.085	82.7	0.0100	9.0
T4	107	0.87	0.500	0.083	85.6	0.0110	8.7
T13	107	0.82	0.500	0.079	72.7	0.0080	9.3
T2	108	0.89	0.499	0.082	84.1	0.0110	9.4
T8	108	0.89	0.499	0.084	93.2	0.0130	8.7
T10	108	0.88	0.499	0.081	94.3	0.0110	9.4
Average		0.89	0.500	0.083	83.9	0.0103	9.0
Std. Dev.		0.04	0.001	0.002	5.9	0.0012	0.3

Lot 2, Compression Testing of AS4/3501-6, Fill, 240 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
CT-2	105	0.92	0.499	0.084	47.4	0.0178	8.6
CT-3	105	0.91	0.499	0.085	45.7	0.0157	8.1
CT-7	105	0.93	0.500	0.085	42.5	0.0141	7.4
CT-010	106	0.93	0.502	0.084	42.4	0.0318	7.8
CT-011	106	0.91	0.502	0.083	36.2	0.0108	8.2
CT-013	106	0.97	0.500	0.080	39.8	0.0060	9.2
T1	107	0.84	0.502	0.084	44.5	0.0153	9.1
T5	107	0.86	0.503	0.084	45.9	0.0062	7.9
T8	107	0.88	0.520	0.084	43.4	0.0126	9.0
T3	108	0.89	0.502	0.083	51.8	0.0048	8.5
T9	108	0.90	0.510	0.083	49.7	0.0100	9.3
T12	108	0.85	0.502	0.081	49.1	0.0128	7.9
Average		0.90	0.503	0.083	44.9	0.0131	8.4
Std. Dev.		0.04	0.006	0.001	4.4	0.0072	0.6

Lot 2, Compression Testing of AS4/3501-6, Fill, 600 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T1	105	0.82	0.500	0.084	3.8	0.0027	2.4
T11	105	0.81	0.501	0.085	3.8	0.0040	1.3
T13	105	0.76	0.501	0.082	4.1	0.0009	1.3
T5	106	0.83	0.502	0.084	3.4	0.0028	3.0
T6	106	0.83	0.502	0.084	3.7	0.0024	2.7
T8	106	0.82	0.500	0.083	4.0	0.0052	1.5
T6	107	0.78	0.502	0.084	4.1	0.0044	1.0
T10	107	0.80	0.503	0.084	3.9	0.0016	1.9
T12	107	0.78	0.520	0.082	3.8	0.0026	1.4
T1	108	0.81	0.502	0.083	4.5	0.0084	2.5
T5	108	0.84	0.510	0.083	3.8	0.0017	2.8
T11	108	0.79	0.502	0.082	4.2	0.0057	2.2
Average		0.81	0.504	0.083	3.9	0.0035	2.0
Std. Dev.		0.02	0.006	0.001	0.3	0.0021	0.7

Lot 2, Compression Testing of AS4/3501-6, Fill, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T4	105	0.85	0.501	0.085	17.1	0.00906	4.8
T10	105	0.95	0.502	0.086	20.0	0.00869	4.8
T12	105	0.93	0.502	0.084	17.3	0.00505	5.5
T1	106	0.98	0.503	0.085	13.6	0.00435	4.0
T7	106	0.93	0.502	0.084	16.2	0.00561	4.2
T9	106	0.88	0.503	0.084	15.1	0.00713	5.0
T3	107	0.77	0.503	0.085	18.8	0.00456	3.6
T9	107	0.77	0.503	0.085	22.3	0.00874	5.6
T11	107	0.77	0.503	0.084	20.6	0.01031	6.0
T6	108	0.79	0.503	0.084	19.6	0.00768	6.6
T7	108	0.79	0.503	0.084	21.3	0.00864	4.5
T13	108	0.77	0.503	0.081	18.9	0.00540	4.7
Average		0.85	0.502	0.084	18.4	0.00710	4.9
Std. Dev.		0.08	0.001	0.001	2.6	0.00203	0.9

Lot 3, Compression Testing of AS4/3501-6, Warp, 75 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L2	109	0.89	0.502	0.088	85.8	0.0114	7.9
L8	109	0.87	0.502	0.088	81.2	0.0102	8.4
L12	109	0.83	0.502	0.089	78.2	0.0166	6.6
L1	110	0.82	0.503	0.087	76.6	0.0101	8.4
L7	110	0.83	0.503	0.086	72.8	0.0093	8.1
L11	110	0.85	0.502	0.086	84.3	0.0110	8.7
L4	111	0.84	0.502	0.087	82.0	0.0101	8.3
L10	111	0.84	0.502	0.088	78.8	0.0099	8.4
L12	111	0.80	0.502	0.085	81.6	0.0115	8.3
L4	112	0.81	0.502	0.086	83.4	0.0109	9.0
L9	112	0.84	0.502	0.087	74.0	0.0098	8.2
L13	112	0.81	0.502	0.085	81.2	0.0121	8.7
Average		0.84	0.502	0.087	80.0	0.0111	8.2
Std. Dev.		0.03	0.000	0.001	4.0	0.0019	0.6

Lot 3, Compression Testing of AS4/3501-6, Fill, 75 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T2	109	0.85	0.502	0.088	82.6	0.01321	7.8
T4	109	0.85	0.502	0.087	82.0	0.01176	8.1
T6	109	0.85	0.503	0.087	87.9	0.01341	8.3
T1	110	0.83	0.502	0.085	85.3	0.01089	9.1
T3	110	0.84	0.502	0.086	84.9	0.01144	8.9
T5	110	0.83	0.503	0.086	92.0	0.01174	8.9
T2	111	0.84	0.503	0.085	73.1	0.00987	8.6
T5	111	0.82	0.502	0.086	78.2	0.01164	8.7
T14	111	0.78	0.501	0.083	78.2	0.01032	8.0
T7	112	0.85	0.502	0.086	76.6	0.00917	8.6
T9	112	0.85	0.502	0.086	85.6	0.01006	9.4
T11	112	0.86	0.503	0.087	77.3	0.00972	8.2
Average		0.84	0.502	0.086	82.0	0.0111	8.5
Std. Dev.		0.02	0.001	0.001	5.5	0.0013	0.5

Lot 3, Compression Testing of AS4/3501-6, Warp, 240 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L1	109	0.85	0.502	0.088	34.5	0.0055	9.8
L3	109	0.90	0.502	0.088	34.1	0.0057	8.9
L5	109	0.93	0.501	0.088	38.2	0.0089	9.3
L5	110	0.86	0.502	0.085	35.0	0.0131	6.2
L9	110	0.84	0.502	0.086	39.5	0.0152	4.9
L13	110	0.79	0.502	0.081	38.5	0.0145	9.9
L7	111	0.85	0.501	0.087	28.2	0.0074	5.8
L9	111	0.86	0.502	0.088	39.8	0.0149	6.8
L11	111	0.85	0.503	0.087	31.7	0.0103	7.8
L6	112	0.83	0.502	0.086	33.2	0.0024	10.8
L7	112	0.81	0.502	0.086	41.6	0.0074	7.5
L11	112	0.84	0.502	0.086	36.3	0.0136	6.9
Average		0.85	0.502	0.086	35.9	0.0099	7.9
Std. Dev.		0.03	0.000	0.002	3.9	0.0043	1.9

Lot 3, Compression Testing of AS4/3501-6, Fill, 240 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T3	109	0.83	0.501	0.088	39.9	0.0077	9.1
T11	109	0.82	0.501	0.087	38.9	0.0096	7.8
T15	109	0.77	0.502	0.083	33.5	0.0101	8.2
T7	110	0.79	0.502	0.085	37.5	0.0087	8.5
T9	110	0.82	0.502	0.086	38.5	0.0086	7.1
T11	110	0.83	0.501	0.087	35.3	0.0049	9.2
T1	111	0.82	0.502	0.086	36.5	0.0076	7.0
T4	111	0.81	0.502	0.084	33.7	0.0065	10.9
T15	111	0.78	0.502	0.080	35.7	0.0067	9.5
T8	112	0.84	0.501	0.086	41.5	0.0138	4.6
T10	112	0.84	0.502	0.087	40.6	0.0129	6.5
T12	112	0.86	0.502	0.087	36.3	0.0096	5.5
Average		0.82	0.501	0.085	37.3	0.0089	7.8
Std. Dev.		0.03	0.000	0.002	2.6	0.0026	1.8

Lot 3, Compression Testing of AS4/3501-6, Warp, 600 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L7	109	0.83	0.502	0.087	5.1	0.0028	1.5
L9	109	0.81	0.502	0.089	4.8	0.0033	3.0
L11	109	0.85	0.502	0.089	4.8	0.0022	2.7
L8	110	0.80	0.502	0.086	4.6	0.0033	1.6
L10	110	0.81	0.502	0.086	4.5	0.0064	1.9
L12	110	0.79	0.502	0.084	5.0	0.0021	2.3
L2	111	0.82	0.503	0.086	4.8	0.0053	2.3
L8	111	0.86	0.502	0.088	4.6	0.0040	1.7
L13	111	0.75	0.502	0.082	4.5	0.0024	2.3
L1	112	0.84	0.503	0.087	4.5	0.0036	1.7
L3	112	0.84	0.502	0.086	5.2	0.0038	1.2
L5	112	0.84	0.502	0.086	4.8	0.0042	2.2
Average		0.82	0.502	0.086	4.8	0.0036	2.0
Std. Dev.		0.03	0.000	0.002	0.2	0.0013	0.5

Lot 3, Compression Testing of AS4/3501-6, Fill, 600 °F

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T8	109	0.85	0.502	0.087	4.4	0.0043	1.3
T10	109	0.82	0.501	0.086	4.6	0.0061	1.8
T12	109	0.83	0.501	0.087	4.6	0.0033	2.6
T2	110	0.80	0.502	0.086	4.8	0.0059	1.7
T8	110	0.80	0.502	0.086	4.6	0.0032	2.5
T13	110	0.79	0.502	0.086	4.6	0.0068	1.6
T7	111	0.81	0.502	0.085	4.7	0.0041	1.7
T9	111	0.80	0.502	0.085	4.8	0.0055	1.4
T11	111	0.82	0.502	0.086	4.6	0.0048	2.3
T6	112	0.81	0.502	0.086	5.0	0.0019	2.8
T13	112	0.82	0.503	0.086	4.7	0.0038	2.2
T15	112	0.75	0.501	0.082	4.1	0.0048	0.7
Average		0.81	0.502	0.086	4.6	0.0045	1.9
Std. Dev.		0.03	0.000	0.001	0.2	0.0014	0.6

Lot 3, Compression Testing of AS4/3501-6, Warp, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
L6	109	0.79	0.501	0.086	26.6	0.0086	6.6
L10	109	0.79	0.502	0.086	27.4	0.0079	5.6
L13	109	0.77	0.502	0.086	23.0	0.0036	7.2
L2	110	0.78	0.502	0.087	22.5	0.0105	4.8
L4	110	0.77	0.502	0.087	25.6	0.0071	6.2
L6	110	0.77	0.502	0.086	24.8	0.0117	5.4
L1	111	0.75	0.502	0.086	24.1	0.0091	5.5
L3	111	0.76	0.503	0.086	24.4	0.0108	4.8
L5	111	0.79	0.503	0.087	25.7	0.0085	5.0
L8	112	0.81	0.502	0.086	23.4	0.0081	5.0
L10	112	0.79	0.502	0.089	21.9	0.0094	5.7
L12	112	0.78	0.502	0.087	24.6	0.0106	6.8
Average		0.78	0.502	0.086	24.5	0.0088	5.7
Std. Dev.		0.02	0.000	0.001	1.6	0.0021	0.8

Lot 3, Compression Testing of AS4/3501-6, Fill, 350 °F*

Specimen ID	Panel Number	Wt. Gain (%)	Width (in.)	Thickness (in.)	Stress (ksi)	Strain (%)	Modulus (Msi)
T5	109	0.84	0.502	0.087	26.7	0.0046	5.6
T9	109	0.84	0.502	0.087	26.0	0.0064	5.1
T14	109	0.83	0.501	0.085	24.9	0.0039	5.9
T6	110	0.82	0.502	0.085	27.4	0.0097	3.2
T10	110	0.86	0.501	0.086	23.3	0.0101	3.8
T15	110	0.79	0.502	0.081	24.2	0.0114	3.8
T8	111	0.84	0.502	0.084	25.4	0.0145	5.0
T10	111	0.84	0.501	0.085	27.7	0.0071	3.7
T12	111	0.85	0.501	0.085	27.5	0.0134	3.8
T1	112	0.85	0.502	0.086	25.9	0.0157	5.7
T3	112	0.85	0.501	0.086	27.2	0.0115	4.8
T5	112	0.83	0.501	0.086	24.6	0.0101	4.0
Average		0.84	0.501	0.085	25.9	0.0099	4.5
Std. Dev.		0.02	0.000	0.002	1.5	0.0038	0.9

Lot 1, In-plane Shear Tests, 75 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (Msi)	τ ₁₂ (ksi)	G ₁₂ (ksi)
CNC-002-103	I10	1.004	0.114		2.6	12.3	
CNC-002-103	I9	1.007	0.116		2.6	11.9	706
CNC-002-103	I1	1.006	0.112		3.0	12.0	789
CNC-SRI-003	I2	1.002	0.116		2.6	11.9	748
CNC-SRI-003	I5	1.008	0.116		2.8	12.1	816
CNC-SRI-003	I7	1.005	0.114		2.8	12.0	739
Average				0.74	2.7	12.0	754
Std. Dev.				witness	0.2	0.2	41

Lot 1, In-plane Shear Tests, 240 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (ksi)	τ ₁₂ (ksi)	G ₁₂ (ksi)
CNC-002-102A	4R	0.995	0.113	0.41	1749	7.7	512
CNC-002-101B	4R	1.000	0.114	0.52	1425	9.1	429
CNC-002-101B	2R	1.000	0.111	0.50	1873	7.4	450
CNC-002-101C	6H	0.999	0.115	0.54	1845	7.0	429
CNC-002-101C	8H	1.000	0.113	0.53	1603	8.0	460
CNC-002-101D	10	0.999	0.108	0.54	2017	8.0	526
Average				0.50	1752	7.9	467
Std. Dev.				0.05	211	0.7	42

Lot 1, In-plane Shear Tests, 350 °F*

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (ksi)	τ ₁₂ (ksi)	G ₁₂ (ksi)
CNC-002-104	I7	0.996	0.113	0.41	380	2.9	96
CNC-002-103	I5	1.001	0.113	0.38	776	3.7	117
CNC-002-103	I3	0.999	0.113	0.37	598	3.5	152
CNC-002-101	I9	1.002	0.113	0.43	374	4.0	83
CNC-002-101	I3	0.998	0.113	0.46	696	4.5	179
CNC-002-101	I1	1.002	0.113	0.43	396	3.6	85
Average				0.41	537	3.7	119
Std. Dev.				0.03	177	0.5	39

Lot 1, In-plane Shear Tests, 350 °F*

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (ksi)	τ ₁₂ (ksi)	G ₁₂ (ksi)
CNC-002-102A	5H	1.000	0.113	0.41	291	1.7	75
CNC-002-101B	3R	1.003	0.115	0.52	807	3.0	189
CNC-002-101C	2R	1.002	0.111	0.54	580	2.3	137
CNC-002-101C	5H	1.002	0.114	0.55	506	3.3	179
CNC-002-101D	6H	1.000	0.113	0.55	284	3.7	93
CNC-002-101D	9H	1.000	0.113	0.57	436	2.9	171
Average				0.52	484	2.8	141
Std. Dev.				0.06	197	0.7	48

Overall Average

3.3 129.7

Std. Dev.

0.7 43.2

Lot 1, In-plane Shear Tests, 550 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (ksi)	τ ₁₂ (psi)	G ₁₂ (ksi)
CNC-002-104	I3	0.998	0.113			718	
CNC-002-104	I5	0.999	0.112		93	687	24
CNC-002-102	I3	0.998	0.111		102	588	24
CNC-002-102	I5	1.000	0.111		104	581	22
CNC-002-101A	I3	1.000	0.114		96	679	23
CNC-002-101A	I5	0.998	0.113		96	629	19
Average				0.46	98	647	22
Std. Dev.					4	56	2

Lot 1, In-plane Shear Tests 550 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (ksi)	τ ₁₂ (psi)	G ₁₂ (ksi)
CNC-002-102A	8H	0.999	0.111	0.41	99	556	22
CNC-002-102A	9H	1.002	0.111	0.41	118	788	28
CNC-002-101B	S1R	1.002	0.107	0.46	136	743	31
CNC-002-101B	10	1.000	0.109	0.49	133	834	33
CNC-002-101C	10	0.999	0.109	0.54	149	866	40
CNC-002-101D	8H	1.000	0.113	0.55	106	636	25
Average				0.48	124	737	30
Std. Dev.				0.06	19	120	6

Overall Avg

692.0

26.4

Std. Dev.

100.8

6.1

Lot 1, In-plane Shear Tests, 350 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (ksi)	ν _{xy}	τ ₁₂ (psi)	G ₁₂ (ksi)
102A	2R	1.001	0.112	0.35	1356	1.54	244	48
102A	3R	1.002	0.115	0.35	1255	1.83	262	46
101B	8H	1.001	0.116	0.44	1889	1.85	328	58
101B	9H	0.999	0.115	0.45	3337*	2.27*	584*	89*
101D	2R	0.999	0.114	0.46	2305	0.90	241	63
101D	4R	1.000	0.115	0.46	1109	1.16	153	35
101C	3R	1.001	0.116	0.45	1694	1.64	317	60
101C	7H	1.002	0.116	0.46	2754	0.88	348	93
Average		1.001	0.115	0.43	1766	1.40	310	62
Std. Dev.		0.001	0.001	0.05	598	0.42	127	20

Lot 1, In-plane Shear Tests, 480 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	E _{xy} (ksi)	ν _{xy}	τ ₁₂ (psi)	G ₁₂ (ksi)
102A	1R	1.000	0.110	0.35	874	1.97	242	40.7
102A	6H	1.001	0.114	0.35	915	1.79	242	43.4
101B	6H	1.003	0.116	0.43	933	0.68	168	50.2
101B	7H	0.998	0.116	0.42	907	1.10	181	43.0
101C	1R	1.001	0.111	0.45	994	1.45	238	48.5
101C	4R	1.000	0.116	0.48	918	1.03	172	42.4
101D	3R	1.003	0.115	0.48	937			
101D	5H	1.000	0.116	0.48	917	1.27	186	40.9
Average		1.001	0.114	0.43	924	1.33	204	44.2
Std. Dev.		0.002	0.002	0.06	34	0.45	35	3.7

Lot 2, In-Plane Shear, 75 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (ksi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
CNC-002-105	3r	1.001	0.113		13.6	0.86	2600	698
CNC-002-105	1r	1.001	0.108		13.9	0.81	2610	722
CNC-002-105	9h	1.003	0.112		14.7	0.78	2975	835
CNC-002-105a	s1r	1.000	0.109		12.9	0.80	2918	809
CNC-002-105a	s9h	1.000	0.113		11.7	0.83	2801	766
CNC-002-106	4r	1.000	0.114		14.0	0.84	2909	790
CNC-002-106	2r	1.003	0.112		14.1	0.75	2947	842
CNC-002-106	10x	1.002	0.110		14.1	0.66	2579	777
CNC-002-107	7h	1.000	0.115		12.7			
CNC-002-107	4r	1.001	0.115		12.5	0.72	2547	741
CNC-002-108	9h	1.001	0.111		13.4	0.85	2658	717
CNC-002-108	7h	1.002	0.114		13.3	0.74	2671	768
Average				0.45%	13.4	0.79	2762	770
Std. Dev.					0.8	0.06	166	45

Lot 2, In-Plane Shear, 240 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (ksi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
CNC-002-105A	S2R	1.000	0.112		7.8	0.780	1253	352
CNC-002-105	5H	1.001	0.114		8.3	0.828	2120	580
CNC-002-105	7H	1.001	0.115		9.2	0.954	2027	518
CNC-002-106	7H	1.001	0.111		8.4	0.978	1756	444
CNC-002-106	9H	1.000	0.111		7.5	0.917	1592	415
CNC-002-107	2R	1.002	0.113		8.0	0.939	1710	441
CNC-002-107	6H	1.000	0.115		6.8	0.727	1245	360
CNC-002-107	10X	1.000	0.113		6.7	0.839	1271	346
CNC-002-108	8H	1.000	0.114		6.6	0.650	1186	359
CNC-002-108	1R	1.001	0.110		8.7	0.418	1106	390
CNC-002-108	3R	1.000	0.114		7.0	0.822	1405	385
Average				0.43%	7.7	0.805	1515	417
Std. Dev.					0.9	0.163	349	75

Lot 2, In-Plane Shear, 350 °F*

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (ksi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
COC-002-108	2R	1.000	0.113		3.2	0.542	342	111
COC-002-108	5H	1.001	0.115		2.7	0.778	239	67
COC-002-108	6H	1.001	0.115		4.0	0.524	306	100
COC-002-107	9H	0.998	0.113		2.4	0.635	238	73
COC-002-106	8H	0.995	0.113		3.0	0.593	273	86
COC-002-106	3R	1.010	0.113		4.6	0.914	440	115
COC-002-106	1R	1.000	0.105		4.1	0.903	506	133
COC-002-105	6H	1.000	0.112		2.6	0.493	238	80
COC-002-105	4R	1.000	0.112		2.8	0.610	369	115
COC-002-105A	S10	1.000	0.109		2.1	0.342	222	83
COC-002-105A	S3R	1.000	0.112		1.9	1.052	352	86
Average					3.0	0.672	320	95
Std. Dev.					0.8	0.214	92	21

Lot 2, In-Plane Shear, 550 °F

Panel ID	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (psi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
CNC-002-105	2R	1.000	0.113	0.46	800	1.06	190	46
CNC-002-105	8H	1.005	0.112	0.48	787	1.06	220	53
CNC-002-105	10X	1.003	0.110	0.45	803	1.00	124	31
CNC-002-105A	S5H	1.000	0.116	0.42	787	0.98	127	32
CNC-002-105A	S6H	0.997	0.116	0.41	758	0.87	134	36
CNC-002-105A	S8H	1.002	0.115	0.42	831	1.43	191	39
CNC-002-106	5H	0.999	0.113	0.41	808	1.45	208	43
CNC-002-106	6H	1.000	0.111	0.39	823	0.92	168	44
CNC-002-107	1R	1.000	0.111	0.39	805	0.75	135	38
CNC-002-107	3R	1.002	0.114	0.43	731	0.92	128	33
CNC-002-108	4R	0.998	0.113	0.40	736	1.12	193	46
CNC-002-108	10X	0.999	0.108	0.41	799	1.05	150	37
Average				0.42	789	1.05	164	40
Std. Dev.				0.03	32	0.21	35	7

Lot 3, In-Plane Shear, 75 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (ksi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
CNC-002	109-005	1.001	0.119	0.34	12.6	0.78	2471	693
CNC-002	109-007	1.001	0.117	0.34	13.3	0.81	2556	706
CNC-002	109A-003	0.997	0.116	0.34	14.1	0.80	2439	677
CNC-002	109A-009	1.000	0.115	0.34	14.1	0.78	2398	675
CNC-002	110-002	1.002	0.115	0.36	13.2	0.89	2768	731
CNC-002	110-005	1.001	0.116	0.34	13.4	0.78	2311	649
CNC-002	110-009	1.000	0.116	0.36	13.2	0.79	2405	670
CNC-002	111-004	1.001	0.116	0.36	14.1	0.77	2385	676
CNC-002	111-010	1.002	0.114	0.35	14.0	0.79	2397	670
CNC-002	112-002	1.002	0.113	0.35	14.9	0.88	2676	712
CNC-002	112-006	1.001	0.117	0.34	14.3	0.85	2472	668
CNC-002	112-007	1.001	0.116	0.34	14.5	0.83	2436	665
Average					13.8	0.81	2477	683
Std. Dev.					0.6	0.04	137	22

Lot 3, In-Plane Shear, 240 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (ksi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
CNC-002	109-004	1.000	0.119	0.37	7.87	1.22	2090	470
CNC-002	109-009	0.999	0.116	0.37	8.84	0.91	2129	558
CNC-002	109-001	1.000	0.113	0.34	9.15	0.95	2460	630
CNC-002	109A-005	1.001	0.117	0.37	8.42	0.83	1691	462
CNC-002	109A-007	1.002	0.117	0.36	7.79	0.69	1286	381
CNC-002	110-007	1.001	0.117	0.37	6.66	1.37	2616	552
CNC-002	110-010	1.001	0.113	0.39		No Test		
CNC-002	111-006	1.001	0.118	0.37	5.96*	* overheated		
CNC-002	111-007	1.000	0.117	0.37	9.63	1.26	2806	620
CNC-002	111-008	1.000	0.116	0.36	8.02	0.99	2283	573
CNC-002	112-010	1.001	0.114	0.37	6.23	1.39	2454	513
CNC-002	112-005	1.000	0.117	0.36		No Test		
Average				0.37	8.1	1.07	2216	529
Std. Dev.				0.01	1.0	0.25	504	76

Lot 3, In-Plane Shear, 350 °F*

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (ksi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
CNC-002	109-005	1.001	0.119	0.34	12.6	0.78	2471	693
CNC-002	109-007	1.001	0.117	0.34	13.3	0.81	2556	706
CNC-002	109A-003	0.997	0.116	0.34	14.1	0.80	2439	677
CNC-002	109A-009	1.000	0.115	0.34	14.1	0.78	2398	675
CNC-002	110-002	1.002	0.115	0.36	13.2	0.89	2768	731
CNC-002	110-005	1.001	0.116	0.34	13.4	0.78	2311	649
CNC-002	110-009	1.000	0.116	0.36	13.2	0.79	2405	670
CNC-002	111-004	1.001	0.116	0.36	14.1	0.77	2385	676
CNC-002	111-010	1.002	0.114	0.35	14.0	0.79	2397	670
CNC-002	112-002	1.002	0.113	0.35	14.9	0.88	2676	712
CNC-002	112-006	1.001	0.117	0.34	14.3	0.85	2472	668
CNC-002	112-007	1.001	0.116	0.34	14.5	0.83	2436	665
Average				0.35	13.8	0.81	2477	683
Std. Dev.				0.01	0.6	0.04	137	22

Lot 3, In-Plane Shear, 550 °F

Panel	Spec. ID	Width (in.)	Thick. (in.)	Wt. Gain (%)	τ_{12} (ksi)	ν_{xy}	E_{xx} (ksi)	G_{12} (ksi)
CNC-002	109-006	1.000	0.116	0.36	0.79	0.67	116	86
CNC-002	109-008	1.000	0.116	0.36	0.85	0.99	156	79
CNC-002	109A-001	1.000	0.109	0.33	0.97	1.10	178	81
CNC-002	109A-004	1.000	0.117	0.34	0.94	0.84	122	73
CNC-002	109A-008	1.000	0.116	0.37	0.96	1.02	131	64
CNC-002	110-004	1.000	0.113	0.37	0.96	0.89	134	75
CNC-002	110-006	1.002	0.114	0.33	0.94	0.99	134	68
CNC-002	111-001	1.000	0.111	0.33	0.98	0.92	150	81
CNC-002	111-005	1.000	0.115	0.36	0.96	1.04	154	74
CNC-002	112-001	1.001	0.109	0.33	0.96	1.54	268	87
CNC-002	112-004	1.000	0.114	0.34	0.95	0.94	133	70
CNC-002	112-009	1.000	0.113	0.35	0.94	0.87	130	74
Average				0.35	0.93	0.99	154	76
Std. Dev.				0.02	0.05	0.21	41	7

Lot 1, Double Notch Shear, 72 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-103	R1	0.68	6650
CNC-003-104	R5	0.73	6098
CNC-003-101A	R5	0.72	7259
CNC-003-101	R3	0.70	6611
CNC-003-103	R3	0.72	7294
CNC-003-101	R1	0.67	7114
Average		0.70	6838
Std. Dev.		0.02	468

Lot 1, Double Notch Shear, 240 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-101A	H5	0.75	3789
CNC-003-104	H5	0.74	4923
CNC-003-101	H7	0.73	3582
CNC-003-101	H3	0.73	4447
CNC-003-101A	H3	0.72	4587
CNC-003-104	H3	0.72	4433
Average		0.73	4294
Std. Dev.		0.01	463

Lot 1, Double Notch Shear, 350 °F*

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-103	H3	0.73	1853
CNC-003-101	H5	0.72	1358
CNC-003-103	H5	0.73	
CNC-003-101	H9	0.72	1638
CNC-003-104	H9	0.73	1162
CNC-003-101A	H9	0.72	1293
Average		0.72	1461
Std. Dev.		0.00	250

Lot 1, Double Notch Shear, 600 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-101	R9	0.71	182
CNC-003-103	R9	0.72	223
CNC-003-104	R9	0.72	211
CNC-003-103	R7	0.73	222
CNC-003-104	R7	0.72	177
CNC-003-101A	R7	0.72	
Average		0.72	203
Std. Dev.		0.00	20

Lot 1, Double Notch Shear, 350 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
104	R1-4	0.63	882
101A	R3-1A	0.67	1024
104	R3-4	0.66	927
101	R5-1	0.66	1046
103	R5-3	0.67	921
101	R7-1	0.67	925
Average		0.66	954
Std. Dev.		0.02	65

Lot 1, Double Notch Shear, 480 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
104	H7-4	0.67	312
101A	H7-1A	0.67	302
103	H7-3	0.66	333
104	H1-4	0.64	323
101A	R9-1A	0.67	356
101A	R1-1A	0.67	385
Average		0.66	335
Std. Dev.		0.01	31

Lot 2, Double Notch Shear, 72 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-105	L1	0.64	6192
CNC-003-105	L11	0.68	6535
CNC-003-105	L16	0.76	6775
Average		0.69	6501
CNC-003-106	17	0.71	6932
CNC-003-106	1	0.65	6251
CNC-003-106	7	0.74	7436
Average		0.70	6873
CNC-003-107	9	0.78	7876
CNC-003-107	19	0.77	7263
CNC-003-107	4	0.70	7279
Average		0.75	7473
CNC-003-108	2	0.67	7316
CNC-003-108	13	0.67	7654
CNC-003-108	20	0.67	6360
Average		0.67	7110
Lot Average		0.70	6989
Std. Dev.		0.05	566

Lot 2, Double Notch Shear, 240 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-105	L13	0.64	4235
CNC-003-105	L2	0.61	3843
CNC-003-105	L9	0.65	3850
Average		0.63	3976
CNC-003-106	2	0.61	3740
CNC-003-106	19	0.65	3855
CNC-003-106	9	0.65	4097
Average		0.64	3897
CNC-003-107	2	0.70	3677
CNC-003-107	14	0.67	3783
CNC-003-107	18	0.70	4119
Average		0.69	3860
CNC-003-108	4	0.70	3596
CNC-003-108	6	0.71	3702
CNC-003-108	12	0.64	3466
Average		0.68	3588
Lot Average		0.66	3830
Std. Dev.		0.03	225

Lot 2, Double Notch Shear, 350 °F*

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-105	L3	0.59	2011
CNC-003-105	L6	0.63	1920
CNC-003-105	L18	0.61	1920
Average		0.61	1950
CNC-003-106	3	0.61	2171
CNC-003-106	6	0.61	1981
CNC-003-106	11	0.59	1583
Average		0.60	1912
CNC-003-107	1	0.62	1780
CNC-003-107	12	0.61	1381
CNC-003-107	20	0.61	1178
Average		0.61	1446
CNC-003-108	1	0.61	1616
CNC-003-108	8	0.63	1791
CNC-003-108	15	0.64	1538
Average		0.63	1648
Lot Average		0.61	1739
Std. Dev.		0.02	288

Lot 2, Double Notch Shear, 600 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-105	L5	0.64	204
CNC-003-105	L10	0.64	252
CNC-003-105	L20	0.63	190
Average		0.64	215
CNC-003-106	4	0.65	251
CNC-003-106	12	0.59	166
CNC-003-106	20	0.63	179
Average		0.62	199
CNC-003-107	5	0.67	226
CNC-003-107	10	0.65	217
CNC-003-107	17	0.67	209
Average		0.66	217
CNC-003-108	5	0.66	176
CNC-003-108	9	0.65	204
CNC-003-108	16	0.66	221
Average		0.65	200
Lot Average		0.64	208
Std. Dev.		0.02	28

Lot 3, Double Notch Shear, 72 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-109	L10	0.64	7136
CNC-003-109	L15	0.64	6370
CNC-003-109	L19	0.63	7349
CNC-003-110	L3	0.62	7472
CNC-003-110	L13	0.61	7986
CNC-003-110	L18	0.67	8238
CNC-003-111	L5	0.74	7335
CNC-003-111	L11	0.66	7249
CNC-003-111	L17	0.78	6290
CNC-003-112	L9	0.65	8121
CNC-003-112	L14	0.67	5851
CNC-003-112	L20	0.60	6921
Lot Average		0.66	7193
Std. Dev.		0.05	743

Lot 3, Double Notch Shear, 240 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-109	L1	0.60	4042
CNC-003-109	L6	0.63	3674
CNC-003-109	L11	0.60	4277
CNC-003-110	L2	0.61	4084
CNC-003-110	L7	0.63	4166
CNC-003-110	L12	0.59	4416
CNC-003-111	L4	0.70	3519
CNC-003-111	L9	0.70	3987
CNC-003-111	L14	0.72	3554
CNC-003-112	L5	0.61	4419
CNC-003-112	L10	0.58	4123
CNC-003-112	L15	0.60	4135
Lot Average		0.63	4033
Std. Dev.		0.05	304

Lot 3, Double Notch Shear, 350 °F*

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-109	L3	0.59	1748
CNC-003-109	L12	0.61	1870
CNC-003-109	L20	0.62	1514
CNC-003-110	L9	0.67	1414
CNC-003-110	L16	0.64	1140
CNC-003-110	L19	0.62	1367
CNC-003-111	L1	0.71	1647
CNC-003-111	L7	0.73	1367
CNC-003-111	L20	0.76	988
CNC-003-112	L2	0.59	1536
CNC-003-112	L7	0.62	1615
CNC-003-112	L18	0.66	1804
Lot Average		0.65	1501
Std. Dev.		0.06	263

Lot 3, Double Notch Shear, 600 °F

Panel ID	Spec.	Wt. Gain (%)	τ_{13} (psi)
CNC-003-109	L5	0.67	98
CNC-003-109	L9	0.68	140
CNC-003-109	L16	0.66	207
CNC-003-110	L4	0.66	119
CNC-003-110	L8	0.65	162
CNC-003-110	L17	0.64	184
CNC-003-111	L6	0.71	233
CNC-003-111	L13	0.70	202
CNC-003-111	L18	0.73	136
CNC-003-112	L4	0.62	186
CNC-003-112	L11	0.59	259
CNC-003-112	L16	0.61	210
Lot Average		0.66	178
Std. Dev.		0.04	48

Lot 1, Edgewise Tension, SC350 Syntactic Core, ASTM D 638

Panel ID (73 °F)	Specimen	Stress (psi)	Modulus (ksi)
CNC-003-101	R2	3749	404
CNC-003-101	R7	3628	393
CNC-003-101	R9	3291	445
Panel Average		3556	414

Specimen (350 °F)	Stress (psi)	Modulus (ksi)
LT8	1779	218
TT13	2839	241
TT16	2356	237
	2324	232

Specimen (480 °F)	Stress (psi)	Modulus (ksi)
LT6	912	87
LT9	813	74
LT12	1218	111
	981	91

CNC-003-103	R1	4206	426
CNC-003-103	R5	4221	421
CNC-003-103	TT3	2922	418
Panel Average		3783	422

LT7	3410	170
TT10	2195	362
TT14	1874	304
	2493	279

LT2	1732	248
TT5	1018	95
TT8	856	87
	1202	143

CNC-004-103	T2R	4256	415
CNC-004-103	T6R	3661	410
CNC-004-103	T74	3787	406
Panel Average		3901	410

T3R	2392	337
T2H	2792	407
T4H	2765	305
	2650	350

T3H	1218	113
T15H	1134	128
T14H	1396	126
	1249	123

CNC-003-104	R8	3810	412
CNC-003-104	R12	3789	407
CNC-003-104	R16	3929	407
Panel Average		3843	409

LT5	2883	601
TT13	2951	490
TT15	2522	334
	2785	475

LT6	1364	108
TT8	1264	105
TT10	1167	101
	1265	104

Lot Average		3771	414
Std. Dev.		386	13

Lot Average	2563	334
Std. Dev.	471	121

Lot Average	1174	115
Std. Dev.	258	45

Lot 2, Edgewise Tension, SC350 Syntactic Core, ASTM D 638

Panel ID (73 °F)	Specimen	Stress (psi)	Modulus (ksi)
CNC-003-105	T3R	3851	443
CNC-003-105	T5R	3550	458
CNC-003-105	T7R	4044	450
Panel Average		3815	450

Specimen (350 °F)	Stress (psi)	Modulus (ksi)
T13	2966	303
T15	2691	210
T3	3604	260
	3087	258

Specimen (480 °F)	Stress (psi)	Modulus (ksi)
T6	1499	150.3
T11	1299	105.6
T10	1429	109.9
T1	1544	134.4
	1443	125.1

CNC-004-106	T1R	2780	422
CNC-004-106	T3R	3514	446
CNC-004-106	T5R	2891	440
CNC-004-106	T6R	2415	443
Panel Average		2900	438

T10	2189	349
T12	2706	260
T3	1970	283
T17	3342	235
	2552	282

T16	1298	113.5
T15	1399	95.3
T5	1132	112.2
T8	1208	89.3
	1259	102.6

CNC-003-107	T1R	4243	430
CNC-003-107	T3R	3198	445
CNC-003-107	T5R	3619	438
CNC-003-107	T6R	3513	458
Panel Average		3643	443

T13	2575	227
T16	2401	256
T9	3150	239
T7	3155	286
	2820	252

T12	1490	116.7
T3	1587	140.4
T5	1285	104.1
T8	1266	129.4
	1407	122.7

CNC-003-108	T1R	3735	465
CNC-003-108	T2R	3842	457
CNC-003-108	T5R	3412	447
CNC-003-108	T7R	3191	457
Panel Average		3545	457

T1	2371	299
T10	2098	448
T11	2010	263
T13	2133	374
	2153	346

T8	893	85.7
T5	843	77.1
T2	821	123.7
T14	851	72.6
	852	89.8

Lot Average		3453	447
Std. Dev.		492	12

Lot Average	2624	286
Std. Dev.	520	63

Lot Average	1240	110.0
Std. Dev.	262	22.4

Lot 3, Edgewise Tension, SC350 Syntactic Core, ASTM D 638

Panel ID (73 °F)	Specimen	Stress (psi)	Modulus (ksi)	Specimen (350 °F)	Stress (psi)	Modulus (ksi)	Specimen (480 °F)	Stress (psi)	Modulus (ksi)
CNC-003-109	2	3725	381	1	1515	128	6	1126	115
CNC-003-109	9	3601	398	3	2541	157	7	1017	92
CNC-003-109	12	3817	381	5	2210	125	8	1022	92
Panel Average		3715	387		2088	137		1055	100

CNC-003-110	1	4107	405	2	2439	185	3	1730	139
CNC-003-110	10	2921	382	9	2854	187	6	1527	139
CNC-003-110	11	3758	405	13	2490	190	7	1504	156
Panel Average		3595	398		2594	187		1587	145

CNC-003-111	6	2845	387	4	2224	162	2	1133	117
CNC-003-111	9	3598	386	7	1838	138	8	953	94
CNC-003-111	12	3493	374	13	1688	125	10	1027	110
Panel Average		3312	383		1917	142		1038	107

CNC-003-112	2	4013	376	8	2589	184	3	1227	135
CNC-003-112	5	4373	397	9	2543	180	4	1186	124
CNC-003-112	12	4212	385	13	2513	211	10	1294	133
Panel Average		4199	386		2549	192		1236	131

Lot		3705	388	Lot	2287	164	Lot	1229	121
Average				Average			Average		
Std. Dev.		467	11	Std. Dev.	407	29	Std. Dev.	242	21

Lot 1, SC350 Syntactic Core, ASTM C 273 Core Shear

Panel ID (73 °F)	Specimen	Stress (psi)
CNC-003-101	2	4703
CNC-003-101	15	4591
CNC-003-101	20	4384
CNC-003-101	24	4499
Panel Average		4544

Specimen (350 °F)	Stress (psi)
1	2868
16	2961
19	2953
6	2823
Panel Average	2901

Specimen (480 °F)	Stress (psi)
5	751
7	761
12	750
17	750
Panel Average	753

CNC-003-102	1	5043
CNC-003-102	4	4693
CNC-003-102	12	4848
CNC-003-102	19	4852
Panel Average		4859

8	3157
9	3179
10	3060
15	3025
Panel Average	3105

5	764
7	779
16	686
18	719
Panel Average	737

CNC-004-103	X8	4632
CNC-004-103	X9	4753
CNC-004-103	X10	4710
CNC-004-103	X17	4798
Panel Average		4723

X3	3031
X11	2934
X12	2882
X21	2866
Panel Average	2928

X6	697
X24	738
X25	739
X23	736
Panel Average	727

Lot Average		4709
Std. Dev.		173

Lot Average	2978
Std. Dev.	115

Lot Average	739
St. Dev.	27

Lot 2, SC350 Syntactic Core, ASTM C 273 Core Shear

Panel ID (73 °F)	Specimen	Stress (psi)
CNC-004-105	13	4685
CNC-004-105	16	4503
CNC-004-105	19	4561
CNC-004-105	35	4377
Panel Average		4532

Specimen (350 °F)	Stress (psi)
15	2922
21	2892
25	2893
38	2747
Panel Average	2864

Specimen (480 °F)	Stress (psi)
14	743
18	755
20	731
26	727
Panel Average	739

CNC-004-106	3	4575
CNC-004-106	11	4267
CNC-004-106	23	4552
CNC-004-106	39	4804
Panel Average		4550

5	2934
17	2602
32	2768
36	2897
Panel Average	2800

8	754
20	718
22	782
37	723
Panel Average	744

CNC-003-108	2	4470
CNC-003-108	6	4919
CNC-003-108	10	4602
CNC-003-108	23	4194
Panel Average		4546

11	2848
15	3043
16	2899
24	3162
Panel Average	2988

1	799
9	797
12	769
20	818
Panel Average	796

Lot Average		4542
Std. Dev.		206

Lot Average	2884
Std. Dev.	141

Lot Average	760
Std. Dev.	33

Lot 3, SC350 Syntactic Core, ASTM C 273 Core Shear

Panel ID (73 °F)	Specimen	Stress (psi)
CNC-003-109	1	3802
CNC-003-109	4	4671
CNC-003-109	7	3599
Panel Average		4024

Specimen (350 °F)	Stress (psi)
2	2469
12	2725
9	2741
Panel Average	2645

Specimen (480 °F)	Stress (psi)
3	789
6	803
8	800
Panel Average	797

CNC-003-110	1	3946
CNC-003-110	4	3888
CNC-003-110	7	3633
Panel Average		3822

2	2694
5	2122
9	2727
Panel Average	2514

3	759
6	797
8	766
Panel Average	774

CNC-003-111	1	4577
CNC-003-111	4	4022
CNC-003-111	7	4622
Panel Average		4407

2	2665
5	2534
9	2914
Panel Average	2704

3	769
6	741
8	780
Panel Average	763

CNC-003-112	1	4278
CNC-003-112	4	4455
CNC-003-112	7	4142
Panel Average		4292

2	2736
5	2889
9	2867
Panel Average	2831

3	808
6	867
8	795
Panel Average	823

Lot Average		4136
Std. Dev.		382

Lot Average	2674
Std. Dev.	218

Lot Average	790
Std. Dev.	32

Lot 1, SC350 Syntactic Core, ASTM C365 Flatwise Compression

Panel ID (73 °F)	Specimen	Stress (ksi)
CNC-003-102	C1	9.9
CNC-003-102	C2	10.2
CNC-003-102	C3	10.3
Panel Average		10.1

Specimen (350 °F)	Stress (ksi)
C4	5.9
C5	5.5
C6	5.6
Panel Average	5.7

Specimen (480 °F)	Stress (ksi)
C7	1.7
C8	1.7
C9	1.6
Panel Average	1.7

CNC-004-101	C1	10.0
CNC-004-101	C2	10.5
CNC-004-101	C3	10.1
Panel Average		10.2

C4	8.5
C5	7.7
C6	7.3
Panel Average	7.8

C7	1.8
C8	1.7
C9	1.7
Panel Average	1.7

CNC-004-102	C1	10.5
CNC-004-102	C2	10.6
CNC-004-102	C3	10.4
Panel Average		10.5

C4	7.4
C5	7.1
C6	7.0
Panel Average	7.2

C7	1.7
C8	1.7
C9	1.6
Panel Average	1.7

CNC-004-104	C1	10.7
CNC-004-104	C2	10.6
CNC-004-104	C3	10.7
Panel Average		10.7

C4	6.2
C5	6.3
C6	6.1
Panel Average	6.2

C7	1.7
C8	1.7
C9	1.7
Panel Average	1.7

Lot Average		10.4
Std. Dev.		0.28

Lot Average	6.8
Std. Dev.	0.93

Lot Average	1.7
Std. Dev.	0.05

Lot 2, SC350 Syntactic Core, ASTM C365 Flatwise Compression

Panel ID (73 °F)	Specimen	Stress (ksi)
CNC-004-105	C1	9.3
CNC-004-105	C2	9.5
CNC-004-105	C3	9.5
Panel Average		9.4

Specimen (350 °F)	Stress (ksi)
C3	5.7
C6	6.0
C8	6.2
Panel Average	6.0

Specimen (480 °F)	Stress (ksi)
C5	2.0
C7	1.9
C9	1.9
Panel Average	2.0

CNC-004-106	C6	9.6
CNC-004-106	C9	9.5
CNC-004-106	C18	8.9
Panel Average		9.3

C2	5.8
C5	5.7
C7	5.6
Panel Average	5.7

C1	1.7
C4	1.6
C8	1.6
Panel Average	1.6

CNC-004-107	C5	9.8
CNC-004-107	C7	9.9
CNC-004-107	C8	9.9
Panel Average		9.9

C1	5.8
C2	5.8
C3	5.7
Panel Average	5.7

C4	1.7
C6	1.6
C9	1.6
Panel Average	1.7

CNC-004-108	C5	9.8
CNC-004-108	C6	9.7
CNC-004-108	C9	9.6
Panel Average		9.7

C2	5.7
C3	5.6
C8	5.7
Panel Average	5.7

C1	1.6
C4	1.5
C18	1.8
Panel Average	1.6

Lot Average		9.6
Std. Dev.		0.28

Lot Average	5.8
Std. Dev.	0.17

Lot Average	1.7
Std. Dev.	0.16

Lot 3, SC350 Syntactic Core, ASTM C365 Flatwise Compression

Panel ID (73 °F)	Specimen	Stress (ksi)	Specimen (350 °F)	Stress (ksi)	Specimen (480 °F)	Stress (ksi)
CNC-004-109	C2	9.4	C3	5.6	C5	1.8
CNC-004-109	C6	9.5	C4	5.5	C8	1.9
CNC-004-109	C17	9.7	C10	5.6	C9	1.9
Panel Average		9.5	Panel Average	5.6	Panel Average	1.9
CNC-004-110	C7	9.7	C1	5.5	C2	2.0
CNC-004-110	C8	9.8	C6	5.5	C5	2.2
CNC-004-110	C20	9.7	C18	5.6	C19	2.1
Panel Average		9.7	Panel Average	5.5	Panel Average	2.1
CNC-004-111	C1	9.1	C7	5.4	C3	2.3
CNC-004-111	C8	9.2	C19	5.5	C6	2.3
CNC-004-111	C18	9.3	C20	5.6	C10	2.5
Panel Average		9.2	Panel Average	5.5	Panel Average	2.4
CNC-004-112	C4	9.4	C2	5.7	C1	2.6
CNC-004-112	C8	9.3	C9	5.4	C5	2.4
CNC-004-112	C18	9.1	C10	5.5	C19	2.5
Panel Average		9.3	Panel Average	5.6	Panel Average	2.5
Lot Average		9.4	Lot Average	5.5	Lot Average	2.2
Std. Dev.		0.23	Std. Dev.	0.09	Std. Dev.	0.26

Sandwich Tensile, 0° Orientation, RT

Sample ID	Width (in.)	Thickness (in.)	Failure Load (lb)	Modulus (psi)	Load/Width (lb/in.)	Load/(w*e) (lb/in.)
101-0-004	0.757	0.497	13014	3429804	17191	1702898
104-0-002	0.756	0.468	13009	3667120	17219	1716212
104-0-003	0.753	0.461	12304	3552874	16350	1637875
104-0-004	0.754	0.497	13503	3568009	17920	1771516
105-0-002	0.753	0.497	12593	3471012	16724	1723358
105-0-004	0.753	0.488	12974	3511563	17230	1713643
106-0-002	0.754	0.500	12778	3419733	16947	1709867
106-0-003	0.752	0.496	13064	3498891	17372	1735450
106-0-004	0.751	0.481	12676	3797304	16878	1826503
Average	0.754	0.487	12879	3546257	17093	1726369
Std. Dev.	0.002	0.014	341	120845	442	51328
COV	0.24	2.90	2.65	3.41	2.58	2.97

Sandwich Tensile, 45° Orientation RT

Sample ID	Width (in.)	Thickness (in.)	Failure Load (lb)	Modulus (psi)	Load/Width (lb/in.)	Load/(w*e) (lb/in.)
102-45-001	0.755	0.440	8948	2487896	11852	1094674
102-45-003	0.757	0.443	8298	2365328	10969	1047840
103-45-004	0.752	0.504	8174	2113245	10870	1065076
104-45-002	0.754	0.495	9009	2159283	11949	1068845
104-45-003	0.751	0.495	8982	2216761	11961	1097297
105-45-001	0.751	0.490	8485	2239293	11298	1097254
105-45-004	0.754	0.490	8867	2310426	11767	1132109
106-45-001	0.755	0.470	8427	2290242	11168	1075268
106-45-004	0.750	0.477	8345	2232825	11127	1065058
Average	0.753	0.478	8615	2268367	11440	1082602
Std. Dev.	0.002	0.023	333	112125	439	25233
COV	0.29	4.84	3.86	4.94	3.84	2.33

Prototype 1 Sandwich Tensile Test Data, RT

Sample ID	Width (in.)	Thickness (in.)	Failure Load (lb)	Load/Strain (lb/in./in.)	Load/Width (lb/in.)	Load/(w*e) (lb/in.)
P1-2	0.753	0.499	13598	1265308	18059	1680356
P1-5	0.753	0.511	12128	1217557	16117	1618016
P1-6	0.753		12424	1291994	16499	1715796
P1-7	0.753	0.501	11618	1227986	15429	1630792
P1-10	0.754	0.496	12108	1185712	16069	1573606
P1-3	0.753	0.497	12935	1138491	17178	1511940
Average	0.753	0.501	12468	1221175	16558	1621751
Std. Dev.	0.000	0.006	702	54985	933	73145

Sandwich Tensile, 45° Orientation, 350 °F

Sample ID	Width (in.)	Thickness (in.)	Failure Load (lb)	Load/Strain (lb/in./in.)	Load/Width (lb/in.)	Load/(w*e) (lb/in.)
101-45-3	0.752	0.471	8106	554423	10779	737265
101-45-4	0.753	0.470	6737	466663	8947	619739
102-45-2	0.752	0.450	6548	528952	8707	703394
102-45-4	0.753	0.453	6955	797607	9236	1059239
103-45-1	0.753	0.511	6968	534739	9254	710145
103-45-3	0.753	0.511	5687	439417	7552	583554
105-45-2	0.754	0.493	7362	661386	9764	877170
105-45-3	0.753	0.492	7972	594771	10587	789868
Average	0.753	0.481	7042	572245	9353	760047
Std. Dev.	0.001	0.024	782	114412	1040	151741

Sandwich Tensile, 0° Orientation, 350 °F

Sample ID	Width (in.)	Thickness (in.)	Failure Load (lb)	Load/Strain (lb/in./in.)	Load/Width (lb/in.)	Load/(w*e) (lb/in.)
103-0-1	0.752	0.501	10449	851560	13895	1132394
103-0-3	0.752	0.502	9812	837100	13048	1113165
103-0-4	0.754	0.509	11301	1523266	14988	2020246
104-0-1	0.752		10705	1045805	14235	1390698
105-0-1	0.752	0.504	12609	1422213	16767	1891240
105-0-3	0.752	0.493	13226	1170846	17588	1556976
106-0-1	0.753	0.510	12943	1019407	17189	1353794
Average	0.752	0.503	11578	1124314	15387	1494073
Std. Dev.	0.001	0.006	1346	265872	1788	352331

Sandwich Open Hole Tensile, 0° Orientation, RT

Specimen ID	Thickness (in.)	Width (in.)	Load (lb)	Load/W (lb/in.)
003-101	0.5400	2.0020	21770	10874
001-102	0.5335	2.0000	22120	11060
006-104	0.4925	2.0000	22280	11140
006-102	0.4480	2.0010	22270	11129
002-101	0.5445	2.0000	19990	9995
006-103	0.5065	2.0005	21490	10742
001-103	0.5075	2.0000	21080	10540
004-104	0.4915	2.0000	22000	11000
Average			21625	10810
Std. Dev.			778	388
COV			3.6	3.6

Sandwich Open Hole Tensile, 0° Orientation, 350 °F

Specimen ID	Thickness (in.)	Width (in.)	Load (lb)	Load/W (lb/in.)
004-101	0.5435	2.0025	21310	10642
001-101	0.5415	1.9700	20920	10619
003-102	0.4655	2.0000	21800	10900
002-102	0.4925	2.0000	23470	11735
002-103	0.4795	2.0010	22890	11439
007-103	0.5070	2.0010	21400	10695
001-104	0.4740	2.0020	22770	11374
007-104	0.4945	2.0015	23240	11611
Average			22225	11127
Std. Dev.			980	462
COV			4.4	4.2

Sandwich Edgewise Compression, 0° Orientation, RT

Sample ID	Load/Strain (lb/in./in.)	Load (lb)
102-0-3		14747
104-0-1	1640106	18911
104-0-4	1586622	17301
105-0-1	1506313	14323
105-0-2	1613693	18469
104-0-2	1390522	16112
106-0-4	1645158	16115
106-0-2	1498876	18880
102-0-4	1532672	17736
Average	1551745	16955
Std. Dev.	86853	1724
COV	5.6	10.2

Sandwich Edgewise Compression, 45° Orientation, RT

Sample ID	Load/Strain (lb/in./in.)	Load (lb)
106-45-?	993763	15919
106-45-4	1096642	15299
103-45-4		12755
104-45-4		13813
105-45-2	1101670	16112
102-45-3	1021147	16288
104-45-4	1063715	13813
Average	1055388	14857
Std. Dev.	47126	1387
COV	4.5	9.3

Sandwich Edgewise Compression, 0° Orientation, 350 °F

Sample ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/Width (lb/in.)
005-102-0-002	0.487	1.002	9909	9889
005-101-0-002	0.476	1.001	9857	9847
005-105-0-003	0.495	1.001	10414	10404
005-103-0-004	0.485	1.000	9161	9161
005-102-0-001	0.474	1.001	12452	12440
005-103-0-002	0.504	1.000	9150	9150
005-101-0-004	0.514	1.002	12062	12038
005-105-0-004	0.501	1.000	10163	10163
Average			10396	10386
Std. Dev.			1234	1228

Sandwich Edgewise Compression, 45° Orientation, 350 °F

Sample ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/W (lb/in.)
005-102-45-001	0.504	1.002	9959	9939
005-102-45-004	0.458	1.001	8344	8336
005-101-45-004	0.476	1.000	8060	8060
005-105-45-004	0.489	1.000	9611	9611
005-103-45-001	0.494	1.003	7918	7894
005-103-45-002	0.502	1.001	7767	7759
005-101-45-002	0.475	1.000	7091	7091
005-105-45-003	0.490	1.002	9113	9095
Average			8483	8473
Std. Dev.			987	984

Prototype Edgewise Compression, RT

Sample ID	Width (in.)	Thickness (in.)	Failure Load (lb)	Load/W (lb/in.)	Load/Strain (lb/in./in.)
Proto1	1.004	0.499	13875	13820	1590813
Proto3	0.997	0.486	15967	16015	1630209
Proto4	1.001	0.507	16884	16867	1435746
Proto6	0.999	0.492	11810	11822	1733069
Proto7	0.999	0.492	17277	17294	1509699
Average	1.000	0.495	15163	15164	1579907
Std. Dev.	0.003	0.008	2290	2299	113819
COV	0.3	1.6	15.1	15.2	7.2

Prototype Edgewise Compression, 350 °F

P1-350	0.498	1.002	10374	20831	
P2-350	0.503	1.003	10486	20847	

Sandwich Edgewise Compression, 0° Orientation, RT, Post 6-Mo Beach Exposure

Specimen ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/W (lb/in.)	Exposure	Coating
007-107A-1	0.497	1.007	16416	16302	Post beach	Hypalon
007-107A-2	0.495	1.003	17643	17590	Post beach	Hypalon
007-107A-5	0.489	1.006	18956	18843	Post beach	Hypalon
007-114A-1	0.497	1.003	16109	16061	Post beach	Hypalon
007-114A-3	0.499	1.012	19176	18949	Post beach	Hypalon
007-114A-4	0.498	1.003	15757	15710	Post beach	Hypalon
007-111B-4	0.493	1.006	17742	17636	Post beach	None
007-111B-5	0.492	1.004	18070	17998	Post beach	None
007-111B-6	0.484	1.007	17294	17174	Post beach	None
007-112B-1	0.492	1.004	16353	16288	Post beach	None
007-112B-2	0.491	1.002	15923	15891	Post beach	None
007-112B-5	0.490	1.004	14768	14709	Post beach	None
Average			17017	16929		
Std. Dev.			1348	1312		
COV			7.9	7.7		
Ratio Hypalon Strength Over Bare				1.04		

Sandwich Edgewise Compression, 0° Orientation, 350 °F, Post 6-Mo Beach Exposure

Specimen ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/W (lb/in.)	Exposure	Coating
007-114A-2	0.497	1.005	9926	9877	Post beach	Hypalon
007-114A-5	0.498	1.005	9731	9683	Post beach	Hypalon
007-114A-6	0.497	1.003	10191	10161	Post beach	Hypalon
007-107A-3	0.492	1.001	8413	8405	Post beach	Hypalon
007-107A-4	0.488	1.003	7031	7010	Post beach	Hypalon
007-107A-6	0.495	1.003	9250	9222	Post beach	Hypalon
007-111B-1	0.490	1.005	9674	9626	Post beach	None
007-111B-2	0.488	1.004	10079	10039	Post beach	None
007-111B-3	0.488	1.001	8344	8336	Post beach	None
007-112B-3	0.493	1.008	8497	8430	Post beach	None
007-112B-4	0.496	1.003	9492	9464	Post beach	None
007-112B-6	0.494	1.004	7699	7668	Post beach	None
Average			9027	8993		
Std. Dev.			1015	1008		
COV			11.2	11.2		
Ratio Hypalon Strength Over Bare			1.01	1.01		

Sandwich Edgewise Compression, 0° Orientation, RT, Post Hot Gas Test

Specimen ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/W (lb/in.)	Exposure	Coating
007-122A-1	0.509	1.002	15016	14986	Post IHGF	Hypalon
007-122A-2	0.512	1.000	15299	15299	Post IHGF	Hypalon
007-112B-4	0.532	1.001	13713	13699	Post IHGF	Hypalon
007-112B-3	0.530	1.001	15368	15353	Post IHGF	Hypalon
007-104B-3	0.462	0.998	12976	13002	Post IHGF	None
007-104B-4	0.462	0.999	14716	14731	Post IHGF	None
007-120B-5	0.487	1.000	16416	16416	Post IHGF	None
007-120B-6	0.487	0.999	15089	15104	Post IHGF	None
Average			14824	14824		
Std. Dev.			1057	1051		
COV			7.1	7.1		
Ratio Hypalon Strength Over Bare				1.00		

Sandwich Edgewise Compression, 0° Orientation, RT, Effect of Delam on First Ply

007-120B-1	0.477	0.999	14461	14475	Post IHGF	None
007-120B-2	0.475	1.009	14937	14804	Post IHGF	None

Sandwich Edgewise Compression, 0° Orientation, 350 °F, Post Hot Gas Test

Specimen ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/W (lb/in.)	Exposure	Coating
007-104B-1	0.464	1.000	8695	8695	Post IHGF	None
007-104B-2	0.463	1.004	9760	9721	Post IHGF	None
007-122A-3	0.513	1.003	10284	10253	Post IHGF	Hypalon
007-122A-4	0.511	1.005	9812	9763	Post IHGF	Hypalon
007-112B-1	0.544	0.996	11221	11266	Post IHGF	Hypalon
007-112B-2	0.541	1.000	11914	11914	Post IHGF	Hypalon
007-120B-3	0.491	1.000	7813	7813	Post IHGF	None
007-120B-4	0.489	1.000	7254	7254	Post IHGF	None
Average			9594	9585		
Std. Dev.			1605	1609		
COV			16.7	16.8		
Ratio Hypalon Strength Over Bare				1.29		

Open Hole Compression, 0° Orientation, RT

Specimen ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/W (lb/in.)
101-001	0.548	1.000	11056	11056
101-004	0.545	1.001	10491	10481
102-005	0.520	1.000	10536	10536
102-006	0.514	1.001	10780	10769
103-007	0.493	1.002	10480	10459
103-008	0.493	1.003	10594	10562
104-004	0.465	1.004	10491	10449
104-006	0.473	1.000	10408	10408
Average			10605	10590
Std. Dev.			214	219
COV			2.0	2.1

Open Hole Compression, 0° Orientation, 350 °F

Specimen ID	Thickness (in.)	Width (in.)	Failure Load (lb)	Load/W (lb/in.)
101-002	0.546	1.002	6889	6875
101-005	0.547	1.005	6493	6461
102-003	0.531	1.000	6668	6668
102-004	0.524	1.002	6679	6666
103-005	0.486	1.003	6548	6528
103-003	0.473	1.001	6017	6011
104-005	0.468	1.002	6727	6714
104-007	0.476	1.002	7299	7284
Average			6665	6651
Std. Dev.			362	362
COV			5.4	5.4

Sandwich Flatwise Tensile, ASTM C 297, RT

Panel ID	Sample ID	Width (in.)	Width (in.)	Thickness (in.)	Load (lb)	Stress (psi)
006-102	FWT-001	1.996	1.993	0.548	9780	2459
006-102	FWT-002	1.997	1.995	0.462	9303	2335
006-102	FWT-004	1.986	1.996	0.534	9507	2398
006-102	FWT-005	1.996	1.995	0.529	9614	2414
006-102	FWT-009	1.995	1.996	0.538	9892	2484
006-102	FWT-010	1.994	1.995	0.543	8159	2051
006-103	FWT-004	1.996	1.997	0.488	8097	2031
006-103	FWT-006	1.997	1.996	0.502	8444	2118
006-103	FWT-008	1.997	1.995	0.488	7892	1981
006-103	FWT-010	1.997	1.996	0.477	6680	1676
006-103	FWT-011	1.997	1.994	0.504	8228	2066
006-104	FWT-001	1.995	1.995	0.490	6336	1592
006-104	FWT-002	1.996	1.994	0.488	8193	2059
006-104	FWT-003	1.994	1.995	0.491	10890	2738
006-104	FWT-005	1.998	1.994	0.499	9234	2318
006-104	FWT-006	1.992	1.984	0.497	7546	1909
Average					8612	2164
Std. Dev.					1218	306
A-Basis						1104

Sandwich Flatwise Tensile, ASTM C 297, 350 °F

Panel ID	Sample ID	Width (in.)	Width (in.)	Thickness (in.)	Load (lb)	Stress (psi)
006-101	FWT-010	1.987	1.995	0.534	3022	762
006-102	FWT-002	1.994	1.986	0.532	3540	894
006-102	FWT-006	1.997	1.992	0.512	3612	908
006-102	FWT-011	1.997	1.997	0.544	4013	1006
006-103	FWT-001	1.996	1.996	0.453	2558	642
006-103	FWT-009	1.997	1.998	0.487	3920	982
006-104	FWT-004	1.998	1.994	0.484	3876	973
006-104	FWT-011	1.994	1.986	0.490	3893	983
Average					3554	894
Std. Dev.					513	128

Compression After Impact, Tested at RT

Panel ID	Sample ID	Impact E (ft-lb)	Failure Load (lb)
CAI-0-006	101-004	0.0	65995
CAI-0-006	102-004	0.0	69035
CAI-0-006	101-006	0.0	70510
CAI-0-006	104-004	5.1	52956
CAI-0-006	103-001	9.7	40163
CAI-0-006	102-002	9.7	40201
CAI-0-006	103-003	9.5	44068
CAI-0-006	102-001	19.6	34724
CAI-0-006	103-006	19.8	31860
CAI-0-006	103-005	19.9	32694
CAI-0-006	104-001	29.4	30812
CAI-0-006	104-003	30.1	33080
CAI-0-006	104-002	29.9	32797

Compression After Impact, Tested at 350 °F

Panel ID	Sample ID	Impact E (ft-lb)	Failure Load (lb)
CAI-0-006	102-006	0.0	33780
CAI-0-006	102-005	0.0	29875
CAI-0-006	101-001	9.7	27972
CAI-0-006	103-004	9.5	27807
CAI-0-006	103-002	9.4	31388
CAI-0-006	102-003	18.1	23970
CAI-0-006	101-002	20.0	23578
CAI-0-006	101-005	20.4	23291
CAI-0-006	104-006	23.5	24408
CAI-0-006	104-005	30.3	25739
CAI-0-006	101-003	29.9	23560

Sandwich Double-Lap Shear Bearing Test, 0° Orientation, RT

Sample ID	Load at 4% (lb)	Max Load (lb)	Inflection Point (lb)	Load/Disp (lb/in.)
106-0-1	5200	6358	5500	531703
103-0-3	5300	6666	5700	686328
104-0-2	4600	6639	5100	438216
102-0-2	4200	6892	5600	422076
101-0-2		6157	5200	
103-0-2	4400	6150	5000	452715
105-0-1	5400	6557	5500	551972
102-0-1	4700	6690	5000	489842
Average	4829	6514	5325	510408
Std. Dev.	472	267	282	91191
COV	9.8	4.1	5.3	17.9

Sandwich Double-Lap Shear Bearing Test, 45° Orientation, RT

Sample ID	Load at 4% (lb)	Max Load (lb)	Inflection Point (lb)	Load/Disp (lb/in.)
105-45-3	4400	6437	5900	422055
104-45-3	4100	6737	5500	425018
106-45-2	5400	6647	6200	553614
102-45-2	3600	6330	5900	363489
106-45-1	4100	6352	5900	420216
105-45-1	4000	6557	5900	377145
Average	4267	6510	5883	426923
Std. Dev.	612	164	223	67267

**Sandwich Double-Lap Shear Bearing, RT
0° Orientation**

Sample ID	Bearing Load (lb)
104-0-3	4059
105-0-3	3566
101-0-3	3437
105-0-3	3650
103-0-1	3366
Average	3616
Std. Dev.	271

**Sandwich Double-Lap Shear Bearing, RT
45° Orientation**

Sample ID	Bearing Load (lb)
45-3-5101	3290
45-3-5102	3592
45-3-5103	3798
45-2-5105	3780
45-1-5103	3637
45-4-5102	3399
45-4-5105	3635
45-4-5101	2895
Average	3503
Std. Dev.	301

**Sandwich Double-Lap Shear Bearing, 480 °F,
0° Orientation**

Sample ID	Bearing Load (lb)
005-102-001	1991
005-106-001	2784
005-101-002	1722
005-103-002	1777
005-103A-002	2372
005-106-002	2041
005-104-001	1965
Average	2093
Std. Dev.	370

**Sandwich Double-Lap Shear Bearing, 480 °F,
45° Orientation**

Sample ID	Bearing Load (lb)
005-103-002	2000
005-101-002	1998
005-101-001	1782
005-104-001	1990
005-104-004	1765
005-106-004	2412
005-106-003	2375
005-106-001	2420
Average	2093
Std. dev	273

Sandwich Single-Lap Shear Bearing, 0° Orientation

Test Temp	Sample ID	Hole End Thickness	Grip End Thickness	Build-Up From 0.4590	Doubled Thickness	Max Load (lbf)	Bearing Stress (psi)
Ambient	001-104	0.4835	0.4715	0.0125	0.9430	8699	71967
	002-104	0.4795	0.4930	0.0340	0.9860	9716	81051
	001-105	0.4900	0.5020	0.0430	1.0040	7657	62506
	003-105	0.4915	0.4995	0.0405	0.9990	7147	58165
	Average	0.4815	0.4823	0.0233	0.9645	9208	76509
	Std. Dev.	0.0028	0.0152	0.0152	0.0304	719	6423

*These samples were tested with different bolts and are not included in the averages.

350 °F	001-103	0.5125	0.4835	0.0245	0.9670	8018	62580
	002-103	0.5125	0.4860	0.0270	0.9720	8196	63969
	003-104	0.4965	0.4845	0.0255	0.9690	8851	71307
	Average	0.5072	0.4847	0.0257	0.9693	8355	65952
	Std. Dev.	0.0092	0.0013	0.0013	0.0025	439	4690

Sandwich Single-Lap Shear Bearing, 45° Orientation

Test Temp	Sample ID	Hole End Thickness	Grip End Thickness	Build-Up From 0.4590	Doubled Thickness	Max Load (lbf)	Bearing Stress (psi)
Ambient	003-102	0.4960	0.4650	0.0060	0.930	7908	63774
	001-104	0.4865	0.4895	0.0305	0.979	8366	68785
	004-104	0.4720	0.4950	0.0360	0.990	8916	75559
	003-105	0.4945	0.4940	0.0350	0.988	8657	70026
	003-106	0.4955	0.4880	0.0290	0.976	8450	68214
	Average	0.4871	0.4916	0.0326	0.9833	8597	70646
	Std. Dev.	0.0109	0.0034	0.0034	0.0068	245	3362

350°	002-104	0.4860	0.4990	0.0400	0.998	7785	64074
	003-104	0.4830	0.4865	0.0275	0.973	6416	53135
	001-106	0.5130	0.4820	0.0230	0.964	7359	57380
	Average	0.4940	0.4892	0.0302	0.9783	7187	58196
	Std. Dev.	0.0165	0.0088	0.0088	0.0176	701	5515

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13. ABSTRACT (Maximum 200 words) Mechanical property characterization was performed on AS4/3501-6 graphite/epoxy and SC350G syntactic foam for the SRB Composite Nose Cap Shuttle Upgrades Project. Lamina level properties for the graphite/epoxy were determined at room temperature, 240 °F, 350 °F, 480 °F, 600 °F, and 350 °F after a cycle to 600 °F. Graphite/epoxy samples were moisture conditioned prior to testing. The syntactic foam material was tested at room temperature, 350 °F, and 480 °F. A high-temperature test facility was developed at MSFC. Testing was performed with quartz lamp heaters and high resistance heater strips. The thermal history profile of the nose cap was simulated in order to test materials at various times during launch. A correlation study was performed with Southern Research Institute to confirm the test methodology and validity of test results. A-basis allowables were generated from the results of testing on three lots of material.				
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